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Angler Effort and Catch in Five Fraser River Chinook Salmon Sport Fisheries, 1990

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by

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CONTENTS

LIST OF FIGURES vi

LIST OF TABLES vii

LIST OF APPENDICES viii

ABSTRACT/RÉSUMÉ x

INTRODUCTION 1

STUDY AREA DESCRIPTION 1
FRASER RIVER 1
SHUSWAP RIVER 1
SOUTH THOMPSON RIVER 1
THOMPSON RIVER 1
VEDDER-CHILLIWACK RIVER 1

FISHERY REGULATIONS 5

METHODS 5
STUDY DESIGN 5
Fraser River 5
Shuswap River 5
South Thompson River 6
Thompson River 6
Vedder-Chilliwack River 6
DATA MANAGEMENT 6
DATA ANALYSIS 7
Fraser River 7
Angler Effort 7
Catch Per Unit Effort 7
Harvest and Release 8
Harvest Rate 9
Angler Characteristics 9
Shuswap River 9
South Thompson River 9
Thompson River 10
Vedder-Chilliwack River 10
Angler Effort 10
Catch Per Unit Effort 10
Harvest and Release 10

RESULTS 10
FRASER RIVER 11
Effort Distribution 11
Angler Effort 11
Daily Profile 11
Total Angler Effort 11
Catch Per Unit Effort 11
Total Catch 11

Angler Characteristics 11
Angler Day Length 11
Target Species 11
Gear Type 11
Previous Trip 11
SHUSWAP RIVER 14
Effort Distribution 14
Angler Effort 14
Daily Profile 14
Total Angler Effort 14
Catch Per Unit Effort 15
Total Catch 15
Harvest Sampling 15
Angler Characteristics 15
Angler Day Length 15
Target Species 15
Gear Type 15
Previous Trip 15
SOUTH THOMPSON RIVER 15
Effort Distribution 15
Angler Effort 15
Daily Profile 15
Total Angler Effort 15
Catch Per Unit Effort 15
Total Catch 16
Angler Characteristics 16
Angler Day Length 16
Target Species 16
Gear Type 16
Previous Trip 16
THOMPSON RIVER 16
Effort Distribution 16
Angler Effort 16
Daily Profile 16
Total Angler Effort 16
Catch Per Unit Effort 16
Total Catch 16
Harvest Sampling 16
Angler Characteristics 16
Angler Day Length 16
Target Species 16
Gear Type 16
Previous Trip 17
VEDDER-CHILLIWACK RIVER 17
Effort Distribution 17
Angler Effort 17
Daily Profile 17
Total Angler Effort 17
Catch Per Unit Effort 17
Total Catch 17
Angler Characteristics 17
Angler Day Length 17

Target Species 17
Gear Type 17
Previous Trip 17

DISCUSSION 17
GENERAL 17
Fraser River 17
Shuswap River 19
South Thompson River 19
Thompson River 21
Vedder-Chilliwack River 22
INCOMPLETE TRIP INTERVIEW BIAS 22

RECOMMENDATIONS 22

SUMMARY 25

ACKNOWLEDGEMENTS 26

REFERENCES 26

LIST OF FIGURES

Figure

1. Study area location map 2

2. Lower Fraser River sport fishery location map 3

3. Shuswap River sport fishery location map 3

4. South Thompson River sport fishery location map 3

5. Vedder-Chilliwack River sport fishery location map 4

6. Hourly angler effort profiles in the 1990 study area sport fisheries 13

7. Fishery performance (angler effort and CPUE) in relation to river level and chinook abundance in the 1989 and 1990 lower Fraser River sport fishery 20

8. Harvest per unit effort of chinook adults, by angler trip duration, in the 1990 study area sport fisheries 24

LIST OF TABLES

Table

1. Sport fishery regulations in the 1990 Fraser River study areas 4

2. Harvest, release and angler effort in the 1990 Fraser River study areas 12

3. Angler characteristics in the 1990 Fraser River study areas 12

4. Harvest rate, catchability and harvest per unit effort (HPUE) in the 1990 Fraser River study areas 18

5. Estimated chinook adult harvest per unit effort (HPUE), by interview type, in the 1990 Fraser River study areas 23

LIST OF APPENDICES

Appendix

1. Interview responses by week at Queen's Island in the July and August 1990 lower Fraser River sport fishery 30

2. Daily angler counts in the July and August 1990 lower Fraser River sport fishery 31

3. Mean hourly proportion of daily angler effort in the 1990 lower Fraser, Shuswap, South Thompson, Thompson (Spences Bridge) and Vedder-Chilliwack sport fisheries 32

4. Daily catch (harvest and release) per angler hour at Queen's Island in the July and August 1990 lower Fraser River sport fishery 33

5a. Interview responses by week at Chuck's Pool in the 1990 lower Shuswap river sport fishery 34

5b. Interview responses by week at Log Dump Pool in the 1990 lower Shuswap River sport fishery 35

5c. Interview responses by week in the roving survey of the 1990 lower Shuswap River sport fishery 36

6a. Daily angler counts by area in the Mara Lake to Ashton Creek section of the 1990 lower Shuswap River sport fishery 37

6b. Daily angler counts by area in the Ashton Creek to Mabel Lake section of the 1990 lower Shuswap River sport fishery 38

7. Daily catch (harvest and release) per angler hour in the 1990 lower Shuswap River sport fishery 39

8. Mean nose-fork length and weight, by flesh colour, age and sex, of chinook salmon harvested in the 1990 lower Shuswap River sport fishery 40

9a. Interview responses by week at Rocky Point in the 1990 South Thompson River sport fishery 41

9b. Interview responses by week in the roving survey of the 1990 South Thompson River sport fishery 42

10. Daily angler counts by area in the 1990 South Thompson River sport fishery 43

11. Daily catch (harvest and release) per angler hour in the 1990 South Thompson River sport fishery 44

12a. Interview responses by week on the east bank (Nicola River mouth) in the 1990 Thompson River (Spences Bridge) sport fishery 45

12b. Interview responses by week on the west bank in the 1990 Thompson River (Spences Bridge) sport fishery 46

13. Daily catch (harvest and release) per angler hour in the 1990 Thompson River (Spences Bridge) sport fishery 47

14. Mean nose-fork length and weight, by flesh colour, age, and sex, of chinook salmon harvested in the 1990 Thompson River (Spences Bridge) sport fishery 48

15. Interview responses by week in the 1990 Vedder-Chilliwack River sport fishery 50

16a. Daily angler counts in the July 1990 Vedder-Chilliwack River sport fishery 51

16b. Daily angler counts in the August 1990 Vedder-Chilliwack River sport fishery 52

17. Daily harvest per angler hour in the July and August 1990 Vedder-Chilliwack River sport fishery 53

18a. Total angler effort, chinook adult harvest and HPUE by trip duration in the July 1990 lower Fraser River sport fishery 54

18b. Total angler effort, chinook adult harvest and HPUE by trip duration in the August 1990 lower Fraser River sport fishery 54

18c. Total angler effort, chinook adult harvest and HPUE by trip duration in the 1990 lower Shuswap River sport fishery 55

18d. Total angler effort, chinook adult harvest and HPUE by trip duration in the 1990 South Thompson River sport fishery 55

18e. Total angler effort, chinook adult harvest and HPUE by trip duration in the 1990 Thompson River (Spences Bridge) sport fishery 56

18f. Total angler effort, chinook adult harvest and HPUE by trip duration in the 1990 Vedder-Chilliwack River sport fishery 56

19. Variance estimation procedure for access point surveys 57

ABSTRACT

Schubert, N.D. and I.W. Whyte. 1992. Angler effort and catch in five Fraser River chinook salmon sport fisheries, 1990. Can. Manuscr. Rep. Fish. Aquat. Sci. 2124: 58 p.

The retention of chinook salmon (*Oncorhynchus tshawytscha*) adults in Fraser River system sport fisheries was eliminated in 1980 in response to escapement declines. Since 1986, improved escapements permitted the reopening of sport fisheries for chinook adults in a number of Fraser River locations. In 1990, chinook fisheries were opened in the Bowron, Clearwater, lower Fraser, Quesnel, lower Shuswap, South Thompson, Thompson and Vedder-Chilliwack rivers. The fisheries were regulated through harvest ceilings, time and area restrictions or daily and annual angler harvest limits. With the exception of the Bowron, Clearwater and Quesnel rivers, each fishery was evaluated using either a roving, access point or hybrid on-site survey.

A total of 4,029 anglers were interviewed in five study areas. An estimated 107,545 angler hours were expended to harvest an estimated 2,216 chinook adults, 38 chinook jacks, 450 rainbow trout, 136 cutthroat trout, 5 Dolly Varden char and 41 sturgeon. Estimated releases totalled 71 chinook adults, 18 chinook jacks, 32 sockeye and 22 rainbow trout. Eighty-two of the chinook adults were marked with adipose fin clips.

The study also identified general biases associated with creel surveys.

Key words: upper Fraser River, sport fisheries, chinook salmon, angler effort, harvest, release, bias.

RÉSUMÉ

Schubert, N.D. and I.W. Whyte. 1992. Angler effort and catch in five Fraser River chinook salmon sport fisheries, 1990. Can. Manuscr. Rep. Fish. Aquat. Sci. 2124: 58 p.

On a interrompu la pêche sportive des saumons quinnats (*Oncorhynchus tshawytscha*) adultes dans le bassin du fleuve Fraser en 1980 en raison du déclin de l'échappée. Depuis 1986, l'augmentation de l'échappée a permis la réouverture de la pêche sportive des quinnats adultes dans plusieurs régions de ce bassin. En 1990, on ouvrait la pêche dans les rivières Bowron, Clearwater, Quesnel, South Thompson, Thompson, Vedder-Chilliwack et dans les cours inférieurs du Fraser et de la Shuswap. La pêche sportive y a été contrôlée par l'imposition de plafonds de prises, de restrictions temporelles et spatiales ou de limites quotidiennes et annuelles de prises. Sauf dans les rivières Bowron, Clearwater et Quesnel, chaque pêche a été évaluée au moyen d'une enquête menée de point d'accès à point d'accès ou hybride, sur le terrain.

En tout, 4 029 pêcheurs sportifs ont été interrogés dans cinq secteurs d'étude. Selon les estimations, 107,545 heures-pêcheurs ont donné lieu à une récolte de 2 216 quinnats adultes, 38 jeunes quinnats mâles, 450 truites arc-en-ciel, 136 truites fardees, 5 Dolly Varden et 41 esturgeon. Les lachers etimatifs comprennent 71 quinnats adultes, 18 jeunes quinnats males, 32 saumons rouges et 22 truites arc-en-ciel. On a marqué 82 des quinnats adultes en coupant leur nageoire adipeuse.

Par ailleurs, la présente étude traite des biais généraux qui se manifestent dans les enquêtes par interrogation des pêcheurs.

Mots-clés: partie supérieure du Fraser, pêches sportives, saumon quinnat, effort de pêche sportive, remise à l'eau, distorsion.

INTRODUCTION

Poor returns of chinook salmon (*Oncorhynchus tshawytscha*) to the Fraser River system led to the closure in 1980 of all chinook adult sport fisheries. Since then, returns have improved to an extent which permitted the reopening of sport fisheries in selected terminal areas (Schubert 1988, 1989, 1990, 1992). In 1990, sport fisheries were opened in the Bowron, Clearwater, lower Fraser, Quesnel, lower Shuswap, South Thompson, Thompson and Vedder-Chilliwack rivers (Fig. 1) and Mabel Lake. In most areas, structured studies monitored fishery performance, evaluated stock impacts and provided the data upon which future management decisions could be made.

This report describes the study design and field procedures and documents the results (angler effort, harvest and release by species) of the 1990 studies in the lower Fraser, lower Shuswap, South Thompson, Thompson and Vedder-Chilliwack rivers. The report concludes with recommendations for the management and assessment of future fisheries.

STUDY AREA DESCRIPTION

FRASER RIVER

Angling in the Fraser River occurs primarily in the lower 120 km (Fig. 2). In 1990, the retention of chinook adults was permitted as far upstream as Alexandra Bridge in the Fraser Canyon; however, this study focused on a 28 km section between the Sumas River mouth and the Agassiz-Rosedale Bridge in July and August. Chinook adults from most Fraser River stocks were available in this fishery.

SHUSWAP RIVER

The Shuswap River originates in the Monashee Mountains of south-central British Columbia and flows in a northwesterly direction, entering Mara Lake east of Salmon Arm. Chinook sport fishing was permitted in the lower Shuswap River, except in a 1 km section above Mara Lake, and in Mabel Lake north of a boundary sign located 4 km south of the lake outlet (Fig. 3). Lower Shuswap chinook were the principle stock in this fishery.

SOUTH THOMPSON RIVER

The South Thompson River originates at Little Shuswap Lake in south-central British Columbia and flows in a westerly direction for 65 km, entering the Thompson River at Kamloops (Fig. 1). Chinook sport fishing was permitted between the Pritchard and Chase bridges (Fig. 4). South Thompson chinook were the principle stock in this fishery.

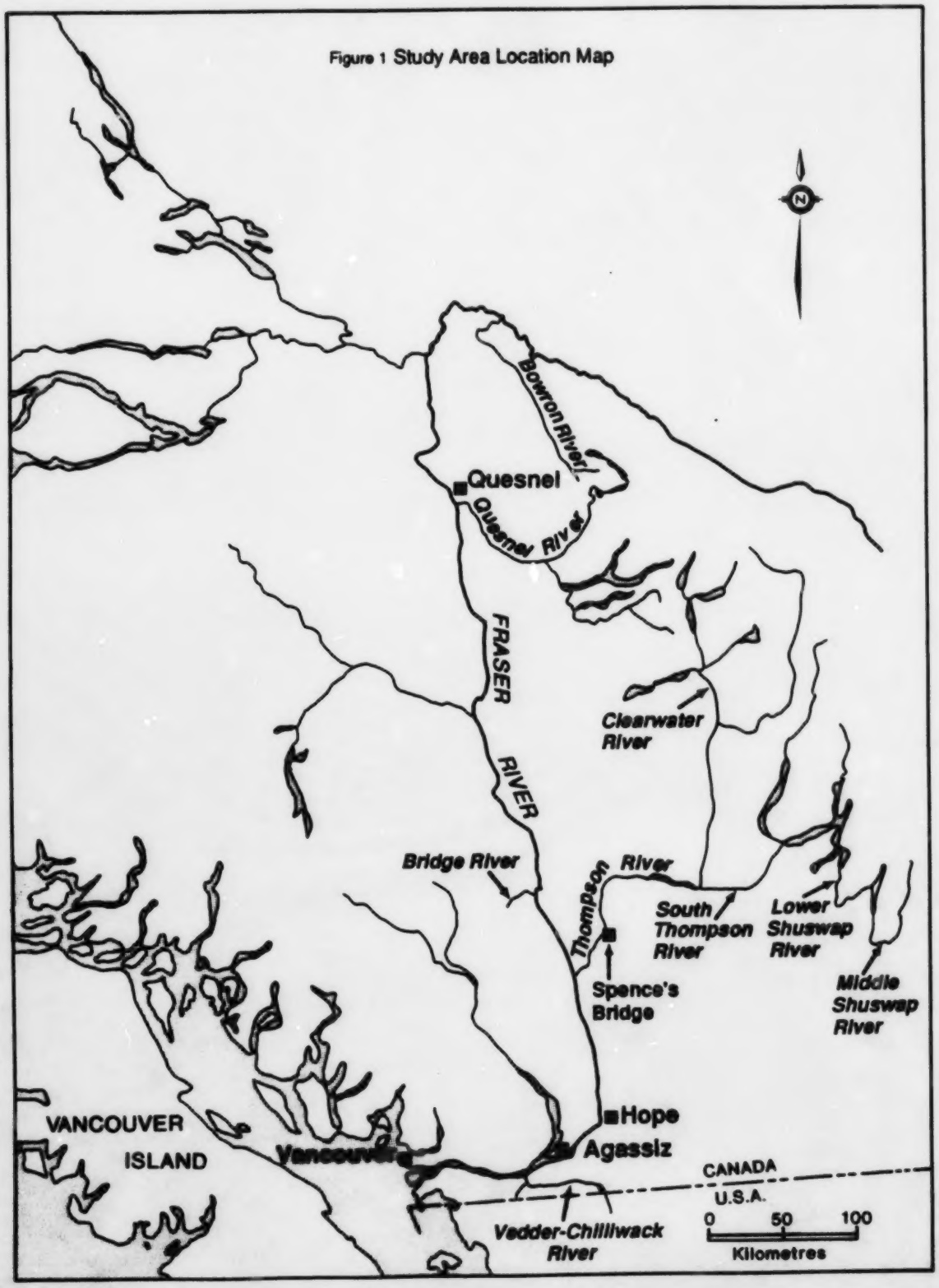
THOMPSON RIVER

The Thompson River arises at Kamloops Lake and flows in a southwesterly direction for 109 km, entering the Fraser River at Lytton (Fig. 1). Chinook sport fishing was permitted on both sides of the river in a 1 km section between the Highway 8 Bridge at Spences Bridge and the upstream bank of the Nicola River. Nicola chinook were the principle stock in this fishery.

VEDDER-CHILLIWACK RIVER

The Vedder-Chilliwack River originates in the Cascade Mountains of Washington State and flows in a northwesterly direction, entering the Sumas River and subsequently the Fraser River near Chilliwack (Fig. 5). The study area extended from the Highway 1 bridge to the fishing boundary at Slesse Creek. Transplanted upper Fraser chinook were the principle stock in this fishery.

Figure 1 Study Area Location Map



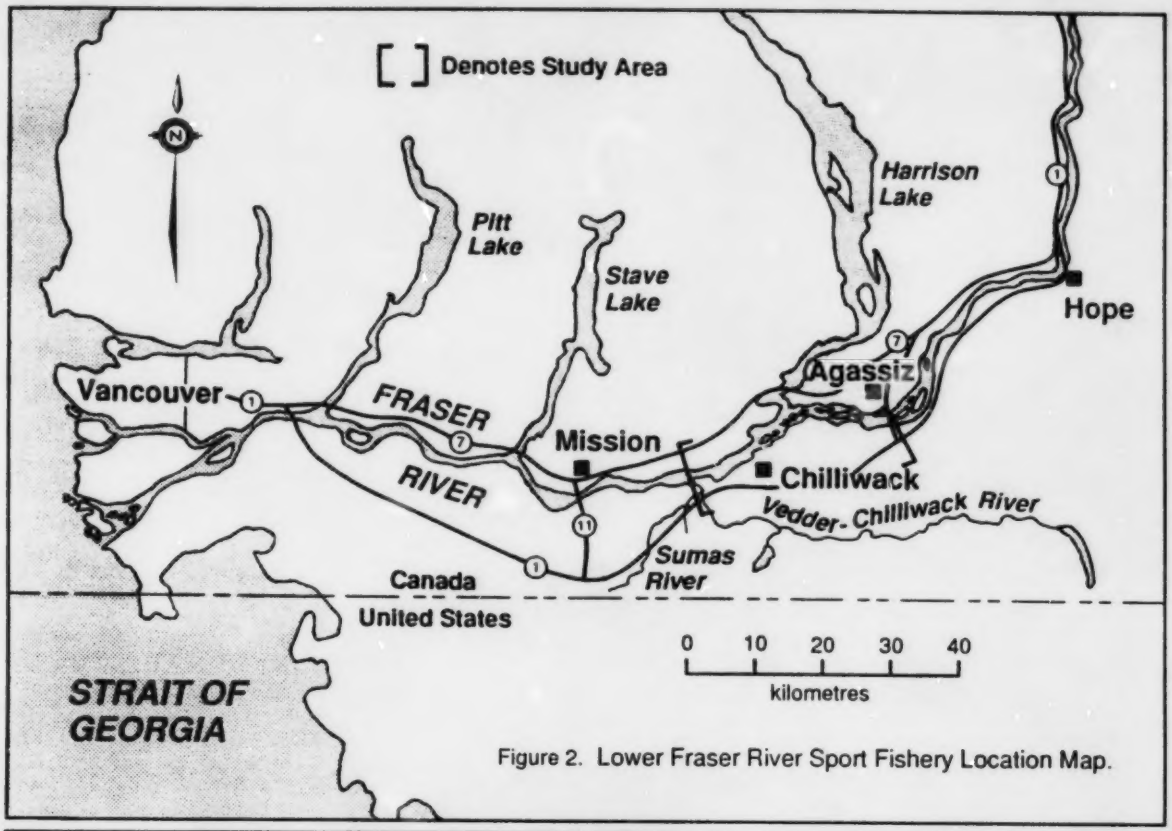


Figure 2. Lower Fraser River Sport Fishery Location Map.

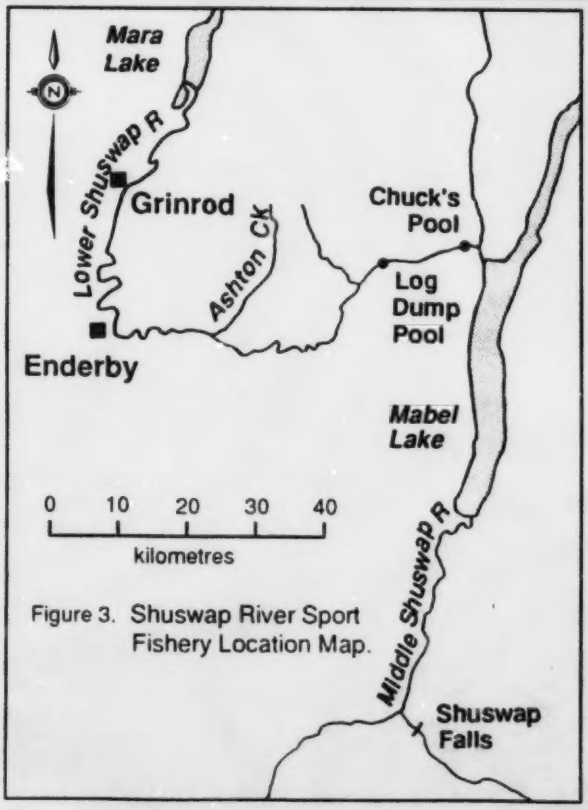


Figure 3. Shuswap River Sport Fishery Location Map.

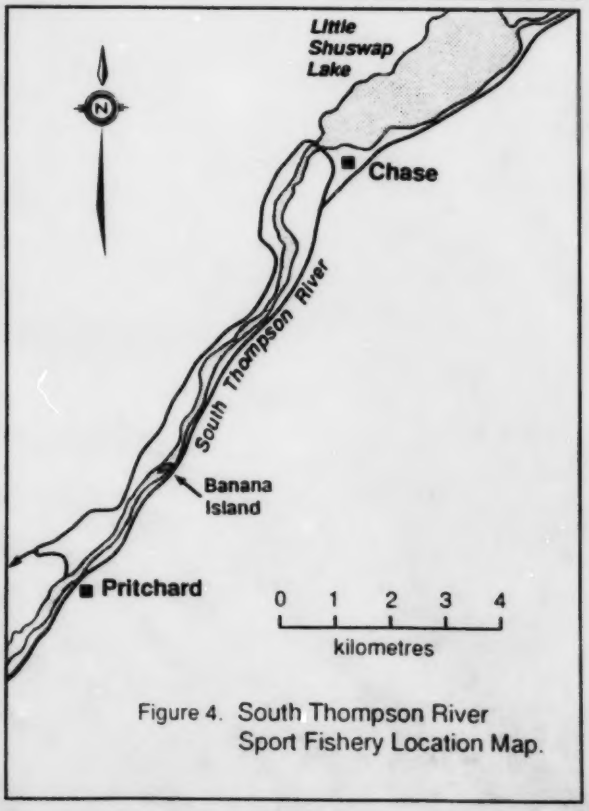


Figure 4. South Thompson River Sport Fishery Location Map.

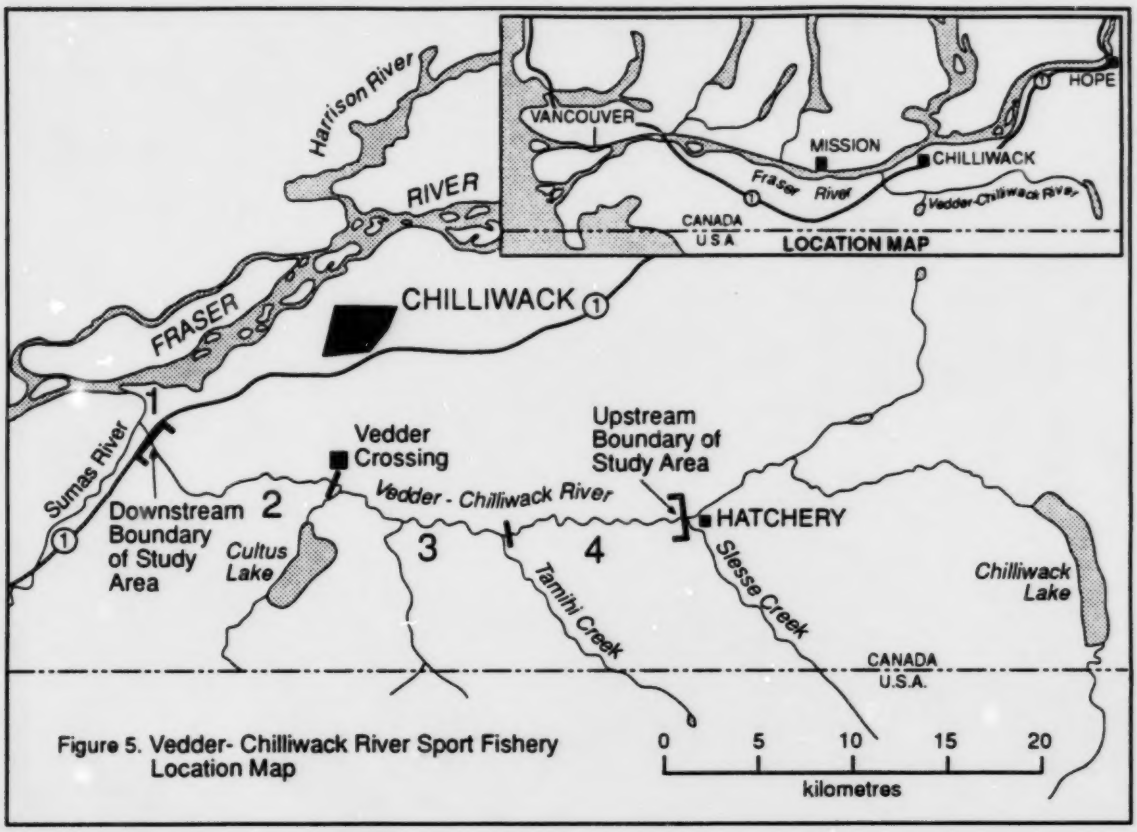


Figure 5. Vedder- Chilliwack River Sport Fishery Location Map

Table 1. Sport fishery regulations in the 1990 Fraser River study areas.

Location	Open Period	Angler catch limits		Days open per week	Total days open	Harvest ceiling
		Daily	Annual			
Fraser River, lower	Jun 1 to Sep 3[a]	1	10	7	85	none
Shuswap River System [b]						
- lower Shuswap River	Aug 15 to Sep 12	2	10	7	28	500
- Mabel Lake	Aug 29 to Sep 8	2	10	7	10	100
South Thompson River [b]	Aug 29 to Sep 19	2	10	7	21	300
Thompson River	Jun 23 to Sep 3	1	10	3[c]	33	300
Vedder-Chilliwack River	Jul 1 to Sep 30	1	10	7	92	none

a. Except Jun 25 to Jul 5 was chinook adult nonretention.
b. Opened and closed at noon.
c. Daily open time was 6 a.m. to 9 p.m.

FISHERY REGULATIONS

In general, the 1990 sport fisheries were managed through restrictions in fishing time, daily and annual angler harvest limits and fishery-specific harvest ceilings (Table 1). The main changes from 1989 (Schubert 1992) were: the lower Shuswap River remained open one week later, an increase from 21 to 28 days; Mabel Lake was opened for the first time; the South Thompson River remained open one week later, an increase from 14 to 21 days; and the Thompson River fishery increased from one to three days per week, opened two weeks earlier and remained open one week later. Fishing time increased from 12 to 33 days, and the harvest ceiling increased from 100 to 300 chinook adults.

METHODS

STUDY DESIGN

Fraser River

The lower Fraser River sport fishery between the Sumas River mouth and the Agassiz-Rosedale Bridge was assessed, using an access point-overflight design (DPA Group MS 1985a), from July 7 to August 26, 1990. The planned June survey start was delayed when high water precluded fishing on Queen's Island. A surveyor worked one of two eight hour shifts (7 a.m. to 3 p.m.; 2 p.m. to 10 p.m.) which encompassed most daylight hours. The study period was stratified by month into weekday and weekend or holiday day types, with weekly assessment of up to three of the former and all of the latter; 35 of the 57 open days were assessed.

The surveyor was stationed at a landing ramp on the south shore of the Fraser River opposite Queen's Island, the area of maximum expected study area angler effort. The surveyor conducted hourly rod counts (using binoculars) and exit interviews. Each interview recorded trip length (to time of interview and expected additional time, if any), target species, number and species harvested or released, identifying marks on harvested fish (fin or maxillary clip), gear type and, if the angler had fished the lower Fraser River within two weeks, trip duration and harvest on the most recent trip. When possible, harvest was inspected to confirm species and mark identification. An interview form was completed for each angler; however, if the angler was unresponsive or if response reliability was questionable, the form was voided.

On six days in July and four days in August, all anglers in the study area were counted from a Cessna 172 aircraft flying at approximately 30 meters and 130 kmh. Independent counts by two observers were made at noon and generally required 40 min.

Shuswap River

The lower Shuswap River sport fishery was assessed, using a hybrid design (Schubert 1988), from August 16 to September 11, 1990. Four surveyors each worked one of two eight hour shifts (5 a.m. to 1 p.m.; 1 p.m. to 9 p.m.). The study period was stratified into weekday and weekend/holiday day types, with weekly assessment of up to three of the former and all of the latter; 21 of the 28 open days were assessed.

Access point surveyors were stationed at Chuck's and Log Dump pools and Enderby Bridge, the areas of maximum expected angler effort. A roving surveyor assessed the remaining areas. Access point survey procedures were identical to those described for the Fraser River, except the chinook harvest was sampled for size (nose-fork length and weight), flesh colour, sex, adipose fin status and scales.

The roving surveyor travelled a predetermined route by automobile, with a randomly selected start point and direction of travel. The surveyor's rate of travel through the fishery was standardized to ensure that a complete circuit encompassed 7 hours. Anglers were approached on foot and interviewed as above. In addition to the interviews, the surveyor conducted a 1 hour instantaneous rod count of the entire study area at one of the two periods of expected daily effort maxima (beginning at 6 a.m. or 7 p.m., depending on the shift). No interviews were conducted during the rod count.

Mabel Lake angler effort was assessed by hourly boat counts from shore and total angler counts from a Cessna 172 aircraft. Because interviews were unobtainable, the survey was abandoned after September 3.

South Thompson River

The South Thompson River sport fishery was assessed, using a hybrid design, from August 31 to September 18, 1990. Two surveyors each worked one of two eight hour shifts (6 a.m. to 2 p.m.; noon to 8 p.m.). The study period was stratified into weekday and weekend/holiday day types, with weekly assessment of up to three of the former and all of the latter; 15 of the 21 open days were assessed.

One surveyor was stationed at Rocky Point, the area of maximum expected angler effort, while a roving surveyor assessed the remaining areas by boat. Access point and roving survey procedures were similar to those described for the Fraser and Shuswap rivers, respectively, except the instantaneous rod count occurred daily at 1 p.m. and required 1 hour.

Thompson River

The Thompson River sport fishery was assessed by complete census from June 23 to September 3, 1990. Surveyors, working the entire daily open period (6 a.m. to 9 p.m.), were stationed at the Nicola River mouth and on the west bank opposite the Nicola River. Because the entire open area was within sight, a secondary surveyor was able to contact other anglers before they left the river. Procedures were identical to the Fraser River study, except instantaneous rod counts were not required and the chinook harvest was sampled for size (nose-fork length and weight), flesh colour, sex, adipose fin status and scales.

Vedder-Chilliwack River

The Vedder-Chilliwack River sport fishery was assessed, using a roving design, from July 1 to August 25, 1990. One surveyor worked one of two eight hour shifts (6 a.m. to 2 p.m.; noon to 8 p.m.). Monthly study period strata included two-hour daily time blocks and weekday and weekend/holiday day types, with weekly assessment of up to three of the former and all of the later; 37 of the 62 open days were assessed.

Roving survey procedures were similar to the lower Shuswap study, except instantaneous rod counts required two hours. Approximately 30% of the rod counts were during the noon to 2 p.m. time block; the remainder were conducted at random.

DATA MANAGEMENT

Data storage and analysis were conducted on an IBM-AT compatible microcomputer. A custom designed data entry program (DPA Group Inc. MS 1985b) generated ASCII files which were either imported into an analysis program (access point and hybrid studies) (DPA Group Inc. MS 1986) or a spreadsheet program (roving study) for analysis.

The data were verified in three

steps. First, all field data sheets were examined for compliance with study procedures. Second, the data entry program performed 31 automatic error checks, including duplication detection, code validity, and range and consistency verification. Third, the ASCII data files were imported to a spreadsheet program for final verification with the field data sheets.

DATA ANALYSIS

Fraser River

Angler Effort: Daily angler effort profiles were generated from hourly rod counts at Queen's Island, with effort before 7 a.m. reconstructed from interview data. Hourly effort was weighted to compensate for the sampling imbalance which resulted from overlapping survey shifts.

Mean sample day angler effort (hours) for each stratum was the ratio of the mean overflight rod count and the proportion of daily effort occurring during the rod count time block (noon to 12:40 p.m.). Total angler effort was the product of the mean daily angler effort and the number of days in the stratum. The mathematical relationships are reported below. Variance calculations are detailed in Appendix 19.

1) Estimated total rods fishing ($\hat{R}_{hj}$), by hour and day type (weekday or weekend):

$$\hat{R}_{hj} = \sum_i N_h / n_{hij} \sum_k r_{hijk}$$

2) Estimated proportion of daily angler effort occurring during the instantaneous rod count time block ($\bar{p}_{hj\bullet}$), by day type:

$$\bar{p}_{hj\bullet} = \frac{\hat{R}_{hj\bullet}}{\sum_j \hat{R}_{hj}}$$

3) Estimated mean rod count during the instantaneous rod count time block ($\bar{y}_{hj\bullet}$), by day type:

$$\bar{y}_{hj\bullet} = \sum_k \frac{y_{hj\bullet k}}{n_{hj\bullet}}$$

4) Estimated angler effort (E_h), by day type, in hours:

$$E_h = N_h \frac{\bar{y}_{hj\bullet}}{\bar{p}_{hj\bullet}}$$

5) Estimated study period angler effort (E), in hours:

$$E = \sum_h E_h$$

where:

- N_h = total days of day type h (weekday or weekend) in the month;
- n_{hij} = number of interview sample days on day type h at site i (Queen's Island) during hour j;
- r_{hijk} = rod count on day type h at site i at hour j on day k;
- $\hat{R}_{hj\bullet}$ = estimated total effort (hours) on day type h during the instantaneous rod count time block (j);
- $y_{hj\bullet k}$ = instantaneous rod count on day type h on day k;
- $n_{hj\bullet}$ = number of instantaneous rod counts on day type h.

Catch Per Unit Effort: CPUE was calculated by species and mark group using a total ratio estimator (Von Geldern, Jr. and Thomlinson 1973; Malvestuto 1983), i.e. the total estimated catch was divided by the total estimated effort (to time of interview). Estimates were derived from interview data weighted by the proportion of monthly stints which were surveyed (the day was di-

vided into three stints: 7 a.m. to 2 p.m.; 2 p.m. to 3 p.m.; and 3 p.m. to 10 p.m.) to account for sampling imbalances resulting from overlapping survey shifts and the proportion of anglers in each hour who left the site without an interview. CPUE was calculated separately for harvested (HPUE) and released (RPUE) fish; however, RPUE was not calculated by mark type because angler mark recognition was considered unreliable. The mathematical relationships are reported below.

6) Estimated study period catch to time of interview at the survey site ($\hat{X}_h$), by day type:

$$\hat{X}_h = \sum_I \sum_I \frac{1}{a_{hil}} \sum_f \sum_q \sum_u \frac{x_{hilfqu}}{a_{hilfq}}$$

7) Estimated study period angler hours to time of interview at the survey site (T_h), by day type:

$$\hat{T}_h = \sum_I \sum_I \frac{1}{a_{hil}} \sum_f \sum_q \sum_u \frac{t_{hilfqu}}{a_{hilfq}}$$

8) Estimated catch per angler hour at the survey site ($\bar{c}_h$), by day type:

$$\bar{c}_h = \frac{\hat{X}_h}{\hat{T}_h}$$

where:

a_{hil} = proportion of monthly period stints of type 1 for site i (Queen's Island) on day type h which were surveyed;

a_{hilfq} = proportion of anglers leaving in time block q on stint f of stint type 1 at site i on day type h who were interviewed;

x_{hilfqu} = catch to time of interview by angler u leaving in time block q on stint f of stint type 1 at site i on day type h;

t_{hilfqu} = hours fished to time of interview by angler u leaving in time block q on stint f of stint type 1 at site i on day type h.

Before calculating CPUE, the raw interview data were tested for significant differences in CPUE between all interviews and complete trip interviews. The test used, from Cochran (1977), was:

9) Estimated variance of the difference between two ratios ($\mathrm{Var}(\bar{c}_c - \bar{c}_t)$):

$$Var(\bar{c}_c - \bar{c}_t) = Var(\bar{c}_c) + Var(\bar{c}_t)$$

where:

$\mathrm{Var}(\bar{c}_c)$ = variance of CPUE from complete trip interviews:

$$\frac{1}{n(n-1)\bar{t}^2}\left(\sum x_u^2 - 2\bar{c}_c \sum x_u t_u + \bar{c}_u^2 \sum t_u^2\right)$$

$\mathrm{Var}(\bar{c}_t)$ = variance of CPUE from all interviews, calculated as above.

$\bar{t}$ = mean time to interview.

If $(\bar{c}_c - \bar{c}_t) \pm (\text{t-table, } 0.95)(\mathrm{Var}\ (\bar{c}_c - \bar{c}_t)$ did not include zero, the difference was significant; incomplete trip interviews were excluded from the analysis for that site.

Harvest and Release: Total harvest and release, estimated by species and mark group, was the sum of the weekday and weekend/holiday strata estimates. For each stratum, harvest and release was the product of stratum effort and the corres-

ponding value of HPUE or RPUE.

10) Total monthly catch (C):

$$C = \sum_h \overline{c}_h E_h$$

Harvest Rate: In study areas where total chinook adult abundance was known, the harvest rate was the ratio of the estimated harvest and the sum of the estimated harvest and the observed escapement (provided by field staff). Harvest rates were not calculated for other species because total abundance was unknown.

Angler Characteristics: The following unweighed angler attributes were summarized by site and week: party size, mean angler day length (from complete trip, incomplete trip and all interviews), preferred species and gear type. Study period mean angler day length, calculated from complete trip interviews, was estimated from site-specific data weighted by estimated angler effort.

Shuswap River

The lower Shuswap River analysis used the procedure described for the lower Fraser River. Angler effort was calculated from profiles observed at Chuck's and Log Dump pools and from instantaneous counts from the above sites and the roving survey. CPUE data were collected at all sites; however, CPUE was first tested for differences between sites in addition to between interview types (Equation 9). If a significant difference in CUPE was noted between sites, then equations 6, 7 and 8 were replaced with the following:

11) Estimated total catch to time of interview ($\hat{x}_{hi}$), by site and day type:

$$\hat{x}_{hi} = \sum_I \frac{1}{a_{hil}} \sum_f \sum_q \sum_u \frac{x_{hilfqu}}{a_{hilfq}}$$

12) Estimated total angler hours to time of interview ($\hat{t}_{hi}$), by site and day type:

$$\hat{t}_{hi} = \sum_I \frac{1}{a_{hil}} \sum_f \sum_q \sum_u \frac{t_{hilfqu}}{a_{hilfq}}$$

13) Estimated catch per angler hour ($\overline{c}_{hi}$), by site and day type:

$$\overline{c}_{hi} = \frac{\hat{x}_{hi}}{\hat{t}_{hi}}$$

14) Estimated mean catch per angler hour at all sites (weighted by site angler effort) ($\overline{c}_h$), by day type:

$$\overline{c}_h = \frac{\sum_I \overline{c}_{hi} E_{hi}}{\sum_I E_{hi}}$$

where:

E_{hi} = $N \frac{\overline{y}_{hij\bullet}}{P_{hj\bullet}}$

= estimated total angler effort at site i on day type h;

$\overline{y}_{hij\bullet}$ = mean rod count at site i on day type h during the instantaneous rod count time block.

Mabel Lake data were analyzed as above; however, because interview data were unavailable, effort profile tails, CPUE and catch could not be calculated.

South Thompson River

The South Thompson River analysis used the procedures described for the Shuswap River. Angler effort was calculated from the profile observed at Rocky Point and from instantaneous counts from the Rocky Point and roving surveys. CPUE data were collected at all sites.

Thompson River

Thompson River angler effort, CPUE and catch were censused: angler effort and catch were summed from interviews; CPUE was the ratio of catch and effort. The mathematical relationships are reported below.

15) Total angler effort (E), in hours:

$$E = \sum_{I}\sum_{u} t_{iu}$$

16) Total study period catch (C):

$$C = \sum_{I}\sum_{u} x_{iu}$$

17) Total catch per angler hour ($\bar{c}$):

$$\bar{c} = \frac{C}{E}$$

Vedder-Chilliwack River

Angler Effort: Hourly effort profiles were generated from twice daily random rod counts. Because of surveyor error, the rod count data were insufficient to generate both weekday and weekend/holiday profiles. A single profile, therefore, was used for each month.

Mean sample day angler effort was ratio of the mean instantaneous rod count (noon to 2 p.m.) and the proportion of the daily effort occurring during that time block. Total angler effort was the product of the mean daily angler effort and the number of days in the stratum. Formulae 1-5, adjusted to reflect the two-hour sample period, were used to estimate effort. Variance was not calculated due to potential error associated with the use of a single monthly profile.

Catch Per Unit Effort: CPUE was calculated by species and mark group for each month and day type stratum using a total ratio estimator. In general, CPUE was estimated as described for the Fraser River, except observed catch and effort to time of interview were used, and the data were not weighted by the proportion of anglers leaving without being interviewed. CPUE and their variances were calculated as follows:

18) Catch per unit effort ($\bar{c}$):

$$\bar{c} = w_1\left(\sum_{u} x_u / \sum_{u} t_u\right)$$

19) Variance of CPUE ($Var(\bar{c})$)

$$Var(\bar{c}) = (1/\bar{t}^2)\sqrt{\frac{\sum_{u}((x_u-\bar{c})\,t_u)^2}{n(n-1)}}$$

where:

x_u = catch to time of interview of angler u;
t_u = hours fished to time of interview by angler u;
$\bar{t}$ = mean time spent angling to time of interview;
n = number of anglers interviewed in stratum;
w_1 = proportion of stints of type 1 which were surveyed.

Harvest and Release: Total harvest and release, by species and mark group, was calculated as in Equation 10.

RESULTS

Study results for the five Fraser River chinook sport fisheries are summarized in Tables 2, 3, 4 and

5. Based on 4,029 interviews, 107,545 angler hours (23,033 angler days) were expended to harvest (release) 2,216 (71) chinook adults, 38 (18) chinook jacks, 0 (32) sockeye (*O. nerka*), 450 (22) rainbow trout (*O. mykiss*), 136 cutthroat trout (*O. clarki*), 5 Dolly Varden (*Salvelinus malma*) and 41 sturgeon (*Acipenser* spp). Chinook adult harvest rates ranged from 0.7% to 12.0%.

The 1990 fisheries were successful in attracting anglers primarily interested in harvesting chinook salmon; only July Vedder-Chilliwack River anglers fished primarily for trout. The average angler fished for 2.6 to 6.6 hours per day using bait, lures or a combination of the two; few fished with flies. The average angler expended 14 to 132 hours to harvest one chinook adult. Results by study area are detailed below.

FRASER RIVER

Effort Distribution

Nine hundred and twenty-five anglers were interviewed, 551 in July and 374 in August (Appendix 1). Interviews documented 14% of the July effort and 6% of the August effort, (Table 2).

Weekday and weekend rod counts, respectively, averaged 57 and 112 in July and 42 and 127 in August (Appendix 2). In July, 64% of the weekday and 58% of the weekend anglers were observed on Queen's Island, declining to 18% and 29%, respectively, in August.

Angler Effort

Daily Profile: Anglers fished from 5 a.m. to midnight, with 80% of the effort occurring between 8 a.m. and 8 p.m. (Appendix 3; Fig. 6). No major peaks in angler effort were noted.

Total Angler Effort: Study period angler effort totalled 60,152 hours or 9,433 days (Table 2). July and August effort totalled 27,482 and 32,670 hours, respectively. Fifty-one percent occurred on weekend; 61% of the July and 24% of the August effort occurred on Queen's Island.

Catch Per Unit Effort

Chinook adult HPUE, expressed as fish per hour, was 0.0068 in July and 0.0083 in August; RPUE was 0.0002 in July and 0.0000 in August (Appendix 4). HPUE peaked from mid-July to mid-August; few chinook were harvested in early July and late August. HPUE estimates from complete trip and all interviews (Table 5) were not significantly different ($p < 0.05$).

Total Catch

Harvest (release) was estimated at 458 (6) chinook adults (187 (6) in July, 271 in August), 24 chinook jacks, 0 (32) sockeye, 136 cutthroat and 41 sturgeon (Table 2). None of the harvested chinook had an adipose fin clip, nor were any heads submitted to the Mark Recovery Program.

Angler Characteristics

Angler Day Length: Anglers fished an average 6.6 and 6.2 hours per trip in July and August, respectively (Table 3).

Target Species: Anglers attempted to harvest chinook (99%) or trout (1%) (Table 3).

Gear Type: Lures were the most common gear (93%), followed by bait/lure combinations (6%) (Table 3). Less than one percent used bait.

Previous Trip: Seventy-four percent of the anglers had fished the lower Fraser River for chinook within

Table 2. Harvest, release and angler effort in the 1990 Fraser River study areas (95% confidence limits in parentheses).

	Lower Fraser River		Lower Shuswap River	South Thompson River	Thompson River	Vedder-Chilliwack River	
	July	August				July	August
Number of interviews	551 -	374 -	1,121 -	437 -	820	372	354
Percent Interviewed [a]	13.9	6.0	14.2	26.4	100.0	16.0	13.3
Angler effort (hour)	27,482 (12,796)	32,670 (18,477)	28,708 (4,310)	4,227 (1,601)	2,537 -	4,514	7,407
Angler effort (day)	4,164	5,269	7,361	1,321	793	1,736	2,389
Harvest							
Chinook adult	187 (113)	271 (218)	1,415 (427) [b]	39 (27)	187 [c]	14 [d]	103 [e]
Chinook jack	24 (28)	0 -	5 (6)	3 (4)	6 [f]	0	0
Rainbow	0 -	0 -	0 -	13 (16)	4	402 [g]	31 [h]
Cutthroat	0 -	136 (216)	0 -	0 -	0	0	0
Dolly Varden	0 -	0 -	0 -	0 -	0	0	5
Sturgeon	14 (21)	27 (69)	0 -	0 -	0	0	0
Release							
Chinook adult	6 (10)	0 -	20 (16)	8 (14)	37	-	-
Chinook jack	0 -	0 -	17 (20)	0 -	1	-	-
Sockeye	14 (20)	18 (27)	0 -	0 -	0	-	-
Rainbow	0 -	0 -	0 -	22 (18)	0	-	-

a. Ratio of observed (from interviews) and estimated effort.
b. Includes 25 with adipose fin clips.
c. Includes 36 with adipose fin clips.
d. Includes 6 with adipose fin clips.
e. Includes 15 with adipose fin clips.
f. Includes 1 with adipose fin clip.
g. Includes 262 with adipose fin clips.
h. Includes 5 with adipose fin clips.

Table 3. Angler characteristics in the 1990 Fraser River study areas.[a]

	Lower Fraser River		Lower Shuswap River	South Thompson River	Thompson River	Vedder-Chilliwack River	
	July	August				July	August
Mean angler day length (hour)	6.6	6.2	3.9	3.2	3.2	2.6	3.1
Target species (%)							
Chinook	98.9	98.9	98.7	93.8	99.1	32.8	91.2
Trout [b]	1.1	1.1	0.8	5.9	0.9	63.4	5.9
Anything	0.0	0.0	0.5	0.2	0.0	3.8	2.8
Gear (%)							
Bait	1.3	0.3	23.2	6.2	76.4	54.5	3.1
Lure	94.9	90.9	52.1	86.9	13.6	34.6	92.1
Bait/Lure	3.8	8.8	24.2	5.3	9.5	6.5	4.2
Fly	0.0	0.0	0.4	1.6	0.5	4.4	0.6

a. Angler day length is weighted by site; all other data are unweighted.
b. Includes rainbow, whitefish or Dolly Varden.

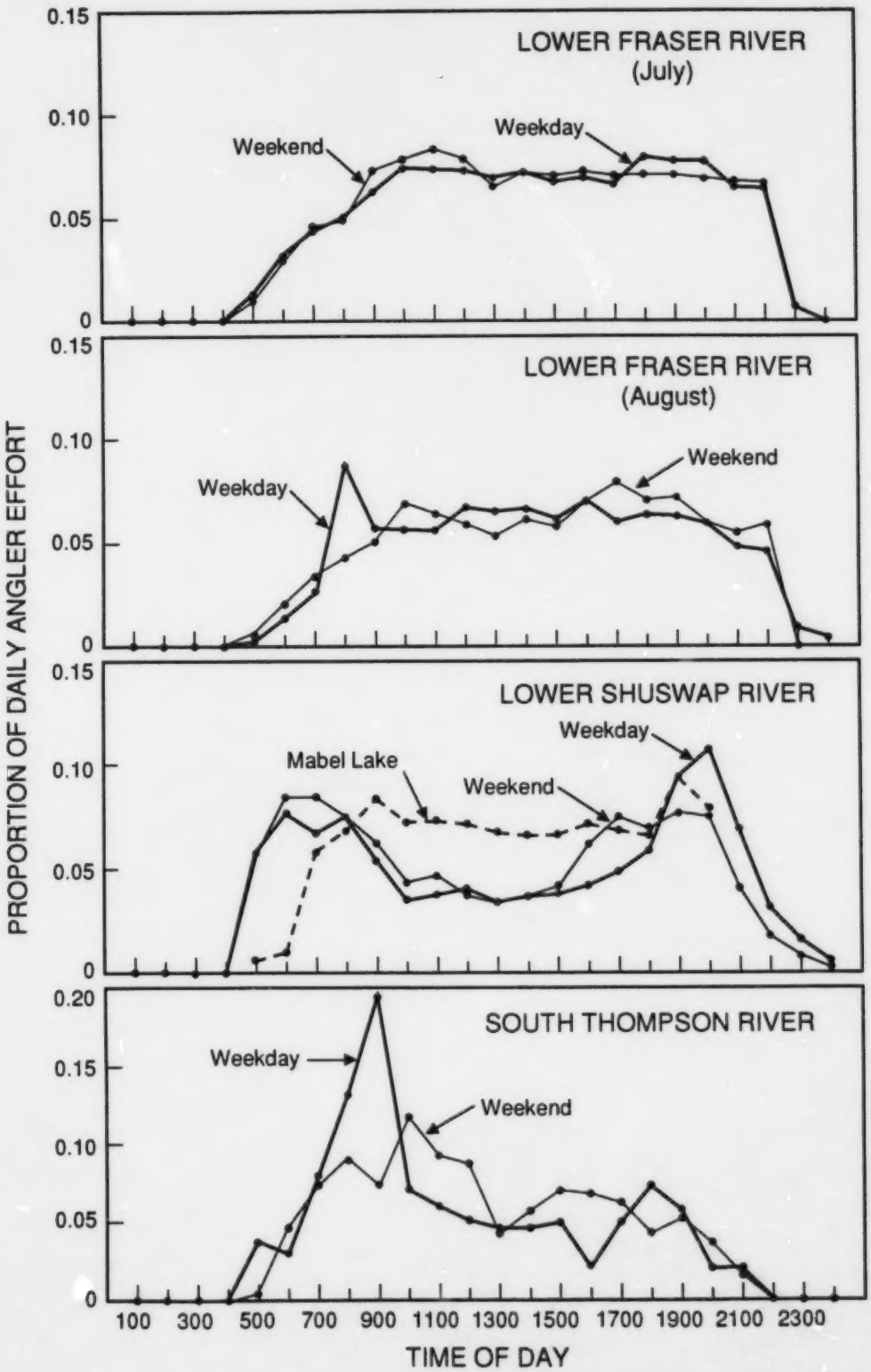


Figure 6. Hourly Angler Effort Profiles in the 1990 Study Area Sport Fisheries.

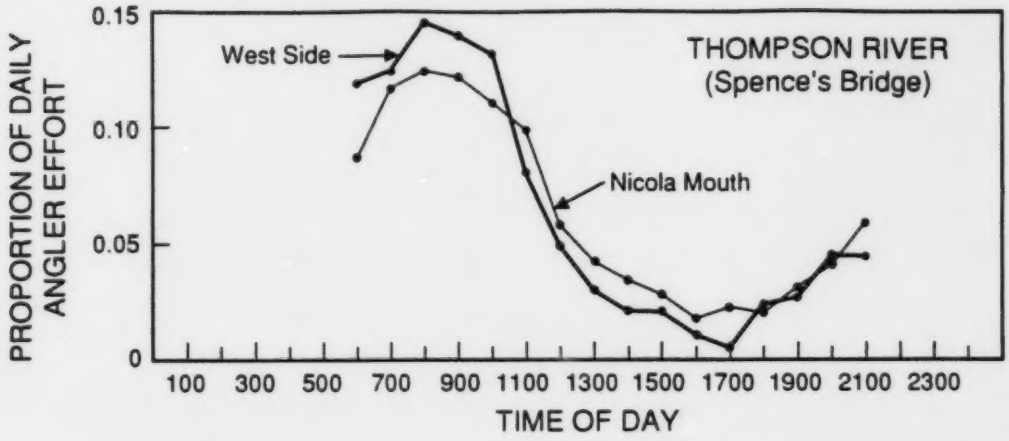


Figure 6 cont'd. Hourly Angler Effort Profiles in the 1990 Study Area Sport Fisheries.

two weeks of the interview (Appendix 1). Chinook adult HPUE on the most recent trip was 0.0072 in July and 0.0064 in August (Table 5).

SHUSWAP RIVER

Effort Distribution

One thousand, one hundred and twenty-one anglers were interviewed (Table 2), 410 at Chuck's Pool, 372 at Log Dump Pool and 339 in the remaining areas (Appendix 5). A further 336 Enderby Bridge interviews were not used in the analysis due to surveyor unreliability. Interviews documented 14% of the total effort (Table 2).

Weekday rod counts averaged 42 and 94 in the morning and evening, respectively, while weekend rod counts averaged 85 and 94, respectively (Appendix 6). Angling occurred near road access points throughout the lower Shuswap River. On weekdays and weekends, respectively, 27% and 36% of the anglers were observed between Mabel Lake and Skookumchuck, 22% and 22% between Fall and Cooke creeks and 20% and 16% between Grinrod and Enderby bridges. Few (less than 5%) angled between Cooke Creek and Skookumchuck (Appendix 6).

Mabel Lake rod counts averaged 68. Most boats fished on the west side approximately 1 km south of the lake outlet.

Angler Effort

Daily Profile: Lower Shuswap River anglers fished from 5 a.m. to midnight (Appendix 3; Fig. 6). Effort was bimodal, with peaks at approximately 6 a.m. and 8 p.m. Mabel Lake effort peaked at 9 a.m. and 7 p.m.; however, effort was relatively constant from 8 a.m. until dark.

Total Angler Effort: Study period angler effort totalled 28,708 hours or 7,361 days in the lower Shuswap River (Table 2) and 8,866 hours in Mabel Lake. Thirty-eight percent of the river effort occurred

on weekends; 28% occurred at Chuck's Pool, 29% at Log Dump Pool, 20% at Enderby Bridge and 22% in the remaining areas.

Catch Per Unit Effort

Chinook adult HPUE was 0.0493; RPUE was 0.0007. Daily HPUE in September was almost double that in August (Appendix 7). HPUE estimates from roving survey complete trip and all interviews (Table 5) were significantly different ($p > 0.05$); roving survey incomplete trip interviews, therefore, were excluded from the analysis. Differences between sites (Appendix 7) were not significant ($p < 0.05$).

Total Catch

Harvest (release) was estimated at 1,415 (20) chinook adults and 5 (17) chinook jacks (Table 2); a further harvest of 100 chinook adults was reported in Mabel Lake (B. Kurtz, pers. comm.). Twenty-five of the harvested chinook adults had an adipose fin clip, with coded wire tags recovered from 16 (64%) heads. Three were 1986-brood middle Shuswap River chinook; 13 were 1986-brood lower Shuswap River chinook.

Harvest Sampling

The sample (N = 56) consisted of red fleshed chinook, with males comprising 25% of the total (Appendix 8). Size averaged 86.2 cm nose-fork length and 7.8 kg round weight. The harvest consisted of ages 5_2 (5%), 4_2 (3%), 4_1 (89%) and 3_1 (3%).

Angler Characteristics

Angler Day Length: Anglers fished an average 3.9 hours per trip (Table 3).

Target Species: Anglers attempted to harvest chinook (99%) or trout (1%) (Table 3).

Gear Type: Lures were the most commonly used (52%), followed by bait /lure combinations (24%) and bait (23%); less than 1% used flies (Table 3).

Previous Trip: Seventy percent of the anglers contacted by the roving surveyor had fished the lower Shuswap River for chinook within two weeks of the interview (Appendix 5). Chinook adult HPUE on the most recent trip was 0.0185 (Table 5).

SOUTH THOMPSON RIVER

Effort Distribution

Four hundred and thirty-seven anglers were interviewed (Table 2), 253 at Rocky Point and 184 in the remaining areas (Appendix 9). Interviews documented 26% of the total effort (Table 2).

Weekday and weekend rod counts averaged 18 and 33, respectively (Appendix 10). On weekdays and weekends, respectively, 52% and 44% of the anglers were observed in the area near Banana Island, 35% and 34% near Prichard, and 9% and 19% near Chase.

Angler Effort

Daily Profile: Anglers fished from 1 a.m. to 11 p.m. (Appendix 3; Fig. 6). Effort peaked at 9 a.m. on weekdays and 10 a.m. on weekends.

Total Angler Effort: Study period angler effort totalled 4,227 hours or 1,321 days (Table 2). Thirty-six percent of the effort occurred on weekends.

Catch Per Unit Effort

Chinook adult HPUE was 0.0092; RPUE was 0.0019. HPUE estimates from complete trip and all interviews (Table 5) and between sites were not significantly different ($p < 0.05$).

Total Catch

Harvest (release) was estimated at 39 (8) chinook adults, 3 chinook jack and 13 (22) rainbow trout (Table 2).

Angler Characteristics

Angler Day Length: Anglers fished an average 3.2 hours per day (Table 3).

Target Species: Anglers attempted to harvest chinook (94%), trout (6%) or anything (less than 1%) (Table 3).

Gear Type: Lures were the most commonly used gear (87%), followed by bait (6%), bait/lure combinations (5%) and flies (2%) (Table 3).

Previous Trip: Sixty-five percent of the anglers had fished the South Thompson River for chinook within two weeks of the interview (Appendix 9). Chinook adult HPUE on the most recent trip was 0.0113 (Table 5).

THOMPSON RIVER

Effort Distribution

Eight hundred and twenty anglers were interviewed (Table 2), 604 on the east bank near the Nicola River mouth and 216 on the west bank (Appendix 12). Interviews and rod counts provide a complete census of the fishery.

Angler Effort

Daily Profile: The 1990 fishery was open from 6 a.m. to 9 p.m. Angler effort peaked at 8 a.m. (Appendix 3; Fig. 6).

Total Angler Effort: Study period angler effort totalled 2,537 hours or 793 days (Table 2). Seventy-six percent of the effort (1,925 angler hours) occurred near the Nicola River mouth.

Catch Per Unit Effort

Chinook adult HPUE and RPUE, respectively, was 0.0707 and 0.0140 at the Nicola river mouth and 0.0833 and 0.0163 on the west bank (Appendix 13). HPUE peaked from late July to mid-August; few were harvested in the initial 4 or final 2 weeks.

Total Catch

Harvest (release) totalled 187 (37) chinook adults, 6 (1) chinook jacks and 4 rainbow trout (Table 2). Three-quarters of the chinook adults were harvested at the Nicola River mouth; 36 adults and 1 jack had adipose fin clips.

Harvest Sampling

The 1990 sample (N = 188) consisted entirely of red fleshed chinook, of which 46.8% were males and 53.2% females (Appendix 14). Size averaged 71.7 cm nose-fork length and 4.0 kg. The harvest consisted of ages 5_2 (19%), 4_2 (64%), 4_1 (5%) and 3_1 (12%). Thirty-three of the 37 chinook without adipose fins had CWTs, all released from the Spius Creek Hatchery: 5, 21 and 5 were Spius Creek Hatchery releases of 1985, 1986 and 1987 brood, respectively, Nicola River chinook and 2 (caught July 23 and August 5) were 1986 brood Coldwater River chinook.

Angler Characteristics

Angler Day Length: Anglers fished an average 3.2 hours per trip (Table 3).

Target Species: Anglers attempted to harvest chinook (99%) or trout (1%).

Gear Type: Bait was the most commonly used gear (76%), followed by

lures (14%), bait/lure combinations (10%), and flies (less than 1%) (Table 3).

Previous Trip: Previous trip information was not collected due to surveyor error.

VEDDER-CHILLIWACK RIVER

Effort Distribution

Seven hundred and twenty-six anglers were interviewed, 372 in July and 354 in August (Appendix 15). Interviews documented 16% of the July effort and 13% of the August effort (Table 2).

Weekday and weekend rod counts, respectively, averaged 13 and 21 in July and 17 and 30 in August (Appendix 16). Most anglers fished between Tamahi and Slesse creeks, especially in August.

Angler Effort

Daily Profile: Angler effort was assessed from 6 a.m. to 10 p.m. July and August angler effort peaked at 9 a.m. and 1 p.m., respectively (Appendix 3).

Total Angler Effort: Study period angler effort totalled 11,921 angler-hours or 4,125 angler days (Table 2); 43% occurred on weekends.

Catch Per Unit Effort

Chinook adult HPUE was 0.0031 in July and 0.0139 in August (Appendix 17); RPUE was not estimated due to surveyor error. HPUE peaked in late August; few were harvested in July. HPUE estimates from complete trip and all interviews (Table 5) were not significantly different ($p < 0.05$).

Total Catch

Harvest was estimated at 117 chinook adults (14 in July and 103 in August), 433 rainbow trout and 5 Dolly Varden char (Table 2). Twenty-one chinook adults and 267 rainbow trout had an adipose fin clip; the latter were residualized hatchery steelhead smolts. Release was not estimated due to surveyor error.

Angler Characteristics

Angler Day Length: Anglers fished an average 2.6 and 3.1 hours per trip in July and August, respectively (Table 3).

Target Species: Anglers attempted to harvest chinook (61%), trout (36%) or anything (3%) (Table 3). The preferred species changed from rainbow (63%) in July to chinook (91%) in August.

Gear Type: Lures were the most commonly used gear (63%), followed by bait (29%), bait/lure combinations (5%) and flies (2%) (Table 3). Gear preference changed from bait (55%) in July to lures (92%) in August.

Previous Trip: Previous trip data were not collected due to surveyor error.

DISCUSSION

GENERAL

Fraser River

The lower Fraser River fishery was the largest of those surveyed, with 56% of the angler effort (Table 4). Fishing success was relatively poor, however, due to the persistence of high water into July (Environment Canada 1991); an average 132 hours were required to harvest one chinook adult. High water delayed the start of the 1990 study until early July.

Early season angling success is a function of: a) river level, which

Table 4. Harvest rate, catchability and harvest per unit effort (HPUE) in the 1990 Fraser River study areas. [a]

Fishery	Year	Angler effort (hr)	Chinook adult harvest	Chinook adult escapement	Catchability coefficient ($x10^6$)	Harvest rate (%)	Mean HPUE
Lower Fraser River, July [b]	1990	27,482	187	-	-	-	0.0068
	1989	64,466	683	-	-	-	0.0106
	1988	57,772	1,400	-	-	-	0.0242
	1987	31,395	1,269	-	-	-	0.0404
	1986	8,550	0	-	-	-	0.0000
Lower Fraser River, August [b]	1990	32,670	271	-	-	-	0.0083
	1987	32,511	64	-	-	-	0.0020
Shuswap River, lower	1990	28,708	1,415	13,000	3.42	9.82	0.0493
	1989	19,449	120	11,000	0.55	1.08	0.0062
	1988	14,288	174	14,000	0.86	1.23	0.0122
	1987	6,071	215	10,000	3.47	2.10	0.0354
	1986	6,145	237	12,000	3.15	1.94	0.0386
South Thompson River	1990	4,227	39	6,000	1.53	0.65	0.0092
	1989	12,118	259	10,000	2.08	2.52	0.0214
	1987	5,671	36	8,500	0.74	0.42	0.0063
Thompson River [c]	1990	2,537	187	2,905	23.84	6.05	0.0737
	1989	1,174	104	5,285	16.76	1.97	0.0886
	1988	1,289	109	4,028	20.44	2.63	0.0846
Vedder-Chilliwack River	1990	11,921	117	859	10.06	11.99	0.0098

a. 1986-89 Shuswap, South Thompson and Thompson data from Schubert (1988, 1989, 1990, 1992).

b. 1986-89 effort and harvest estimated using 1990 procedures and unpublished data; catchability coefficient and harvest rate could not be calculated because stock-specific timing at the fishery site was not known.

c. Assumes fishery harvest was entirely from main Thompson River stocks, i.e. of Bonaparte, Deadman and Nicola chinook.

normally peaks in late May or early June and declines for the balance of the year (Environment Canada 1989). Angler effort is minimal at levels above 7.3 m (Hope gauge) because most effective fishing sites remain under water; and b) average seasonal chinook abundance, which peaks in the test fishery in late June and declines through August (Schubert *et al.* 1988). River level, therefore, by fixing the earliest date of significant angler effort, determines the proportion of the chinook run vulnerable to this fishery. In 1989, 7.3 m occurred in early June when over 75% of the run had yet to pass through the study area (Fig. 7). As a result, effort, CPUE and chinook harvest were relatively high in both June (Schubert 1992) and July (Table 4; Fig. 7). In 1990, 7.3 m occurred in mid July when less than 25% of the run had yet to pass (Fig. 7). As a result, June effort was very low and July effort and chinook adult harvest were 43% and 33%, respectively, of the 1989 levels (Table 4). August flows were near average and angler effort was similar to 1987 (Table 4), although chinook adult harvest was higher.

An assumption underlying the study methodology was that either the interview site was representative of the study area or the proportion of effort occurring at the site was sufficient to make the HPUE estimate insensitive to differences in other areas. In July, over 60% of the study area angler effort occurred at the survey site; therefore, the HPUE estimate was likely insensitive to differences in other areas. With only 24% of the August angler effort at the survey site, violation of the assumption of representativeness became more important. In August 1988, HPUE was estimated at four study area sites, Bowman's, Queen's Island, Wing Dam and Englebrich bars (DFO unpublished). Although between site differences were noted, the only significant difference ($p < 0.05$) in paired comparisons was between Bowman's and Englebrich bars. While study area HPUE was not homogeneous, the similarity in three of the four survey sites suggests the potential impact on study results may have been minor.

Shuswap River

The lower Shuswap River fishery was one of the most intensive in the upper Fraser River system, with considerably greater angler effort and chinook adult harvest than the South Thompson River and Thompson River fisheries combined (Table 4).

The 1990 fishery changed from recent years in a number of important ways. Angling began much later (5 a.m.) and was more concentrated, with 57% of the effort at the two largest sites (Chuck's and Log Dump pools). Total effort increased over 1989 by 48% due to increases in days open from 21 to 28 (33%) and in mean daily angler effort (16%). Chinook adult catchability was similar to 1986-87 but increased by 4.2 and 6.6 times over 1988 and 1989, respectively (Table 4). As a result, harvest and harvest rate increased by 12.6 and 8.7 times over 1988 and 1989 respectively. The reason for these changes is unknown; for example, while flows were above average, they were similar to 1989 levels (Environment Canada 1989, 1991). Changes of this magnitude emphasize the importance of ongoing assessment of intensive fisheries such as the lower Shuswap.

South Thompson River

Angler effort, HPUE and chinook adult catch in the South Thompson River fishery declined from 1989 by 65%, 57% and 85%, respectively (Table 4). Much of the decline may be attributable to the decline in chinook abundance, by 41%, and an effort response to lower success (HPUE declined by 57%). Angler effort declined

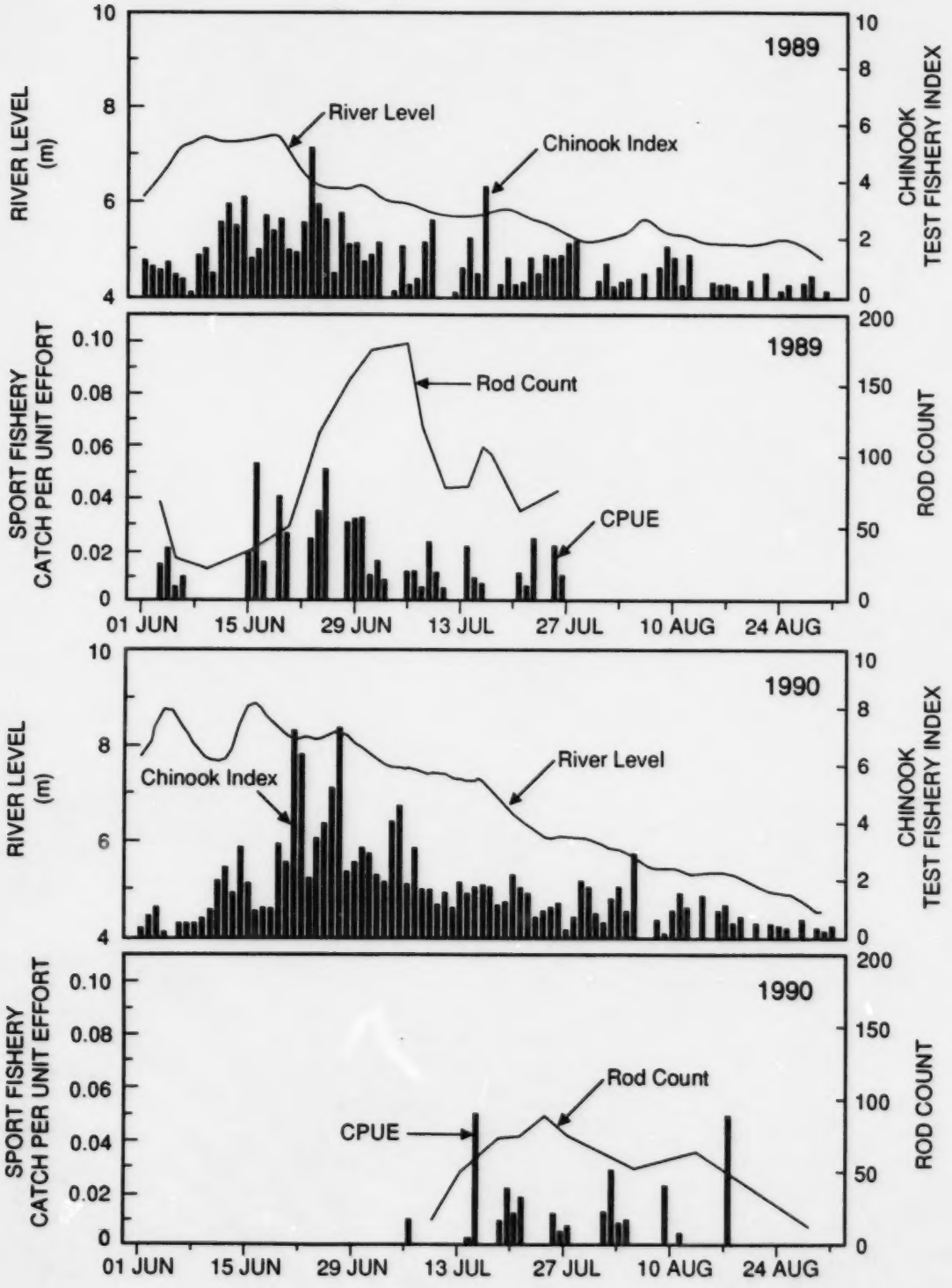


Figure 7. Fishery Performance (Angler Effort and CPUE) in Relation to River Level and Chinook Abundance in the 1989 and 1990 Lower Fraser River Sport Fisheries.

despite an increase in days open from 14 to 21.

It was speculated that the use of the 1987 profile in the 1989 analysis may have introduced error in both the effort and catch estimates (Schubert 1992). The 1990 profile, however, was similar to 1987; effort during the 1990 instantaneous effort count time block (1-2 p.m.) was only 0.7 percentage points lower than in 1987. This suggests that analytic error played no more than a minor role in the differences noted above.

Thompson River

The Thompson River (Spences Bridge) fishery had one of the highest harvest rates and by far the highest HPUE and catchability coefficient observed in 1990 (Table 4). An average of 14 hours were required to harvest one chinook adult. Both HPUE and chinook abundance were lower than in 1989; however, substantial increases in catchability and angler effort produced an 80% increase in chinook adult harvest.

In calculating the 1990 fishery harvest rate, three assumptions were made. First, it was assumed that passing chinook from North and South Thompson River stocks were not vulnerable. The 1988-90 data support this assumption because: a) all CWTs recovered in the fishery were from main Thompson River stocks; b) fish size and age were consistent with main Thompson stocks; and c) timing in the lower Fraser River was consistent with a stock which would be differentially vulnerable while holding in the Thompson River near the tributary of origin (Schubert 1990), i.e. these stocks migrate through the lower Fraser River in May and June but do not enter spawning tributaries until August or September. Second, it was assumed that Thompson River stocks (Bonaparte, Deadman and Nicola) were equally vulnerable to the fishery. Although the 1988-90 data tend to be consistent with this assumption, relatively few CWTs were applied to non-Nicola stocks. The data, therefore, may be insufficient to evaluate this assumption. Third, it was assumed that marked and unmarked chinook were equally vulnerable to the fishery and that escapement was estimated accurately. The 1990 data were inconsistent with these assumptions. The harvest rate calculated from adipose fin clips (AFCs) observed in the catch (37) and estimated in the Nicola River escapement (198; C. Cross, pers. comm.) was 15.7%, over twice the 6.1% estimated in this study. Further, the estimated proportion of AFCs in the Nicola River escapement (8.6%) was much lower than in the fishery harvest (19.8%). There are three possible reasons for these differences: a) anglers may differentially release unmarked chinook as a perceived conservation measure; however, even if all released chinook were unmarked, the proportion with AFCs (16.5%) would remain well above that estimated in the escapement; b) AFC chinook may be more vulnerable to the fishery, perhaps due to different ages at return. Unfortunately, the age composition of the Nicola chinook escapement was not estimated; and c) AFC incidence in the escapement may have been underestimated. In 1989, AFC incidence was estimated from recovered spawning ground carcasses and was similar to the fishery incidence; the 1990 incidence was estimated from a fence which monitored only a component of the run (K. Pitre, pers. com.).

The 1990 sport fishery was expanded in days open and harvest ceiling despite the continuing decline of Nicola River wild chinook escapements. While the 1990 regulations were successful in constraining the fishery within the new 300 harvest ceiling, harvest increased by

80% over 1989. The 1990 escapement, however, was the lowest in almost 20 years. Escapement remains below brood year levels and, even with enhancement, the declining trend which began in 1986 has not been halted. Given the effectiveness of this fishery, restrictive management similar to 1989 should be reimplemented until escapement begins to rebuild.

Vedder-Chilliwack River

The 1990 study evaluated a new fishery on chinook adult returns from upper Fraser River stocks first transplanted to the Vedder-Chilliwack River in 1985. The study was a first assessment of the river during July; the August 1988 river (Whyte and Schubert 1990) and the August 1985 river mouth fisheries (Spence and Murray MS 1986) were assessed previously.

The July fishery targeted primarily on hatchery trout smolts which residualized in the river after release. Over 60% of the anglers fished for trout (Table 3), and rainbow trout accounted for 97% of the harvest (Table 2). In August, chinook became the target species of over 90% of the anglers and made up 74% of the harvest. The August fishery changed substantially from the 1988 pretransplant fishery: angler effort increased by 24%, from 5,973 hours (Whyte and Schubert 1990) to 7,407 (Table 2); target species changed from rainbow or anything (89%) to chinook (an increase from 5% to 90%); gear changed from predominantly bait to almost entirely lures; and harvest changed from entirely trout to predominantly chinook. These results demonstrate the capacity of enhancement to change the nature of a sport fishery.

INCOMPLETE TRIP INTERVIEW BIAS

The 1987 upper Fraser River sport fishery study identified a negative bias in HPUE estimated from incomplete trip interviews, i.e. interviews from anglers contacted during their trip (Schubert 1989). With a maximum daily harvest of one chinook adult, anglers contacted during their trip were unlikely to have harvested a chinook. In 1988-90, this bias was addressed by increasing the maximum daily angler harvest limit from one to two chinook adults per day (Schubert 1990). Survey results suggest this change corrected the bias. In those years, the only significant difference ($p > 0.05$) in complete versus combined trip interview HPUE (Table 5) was in the 1990 Shuswap River roving survey; those data were adjusted to correct the bias. As well, HPUE was clearly independent of trip length (Fig. 8) in the 1990 lower Fraser River and lower Shuswap River fisheries, a basic prerequisite for roving creel survey design. The pronounced positive relationship between HPUE and trip length in the Thompson River did not bias study results because the fishery was censused.

RECOMMENDATIONS

1. The 1990 sport fishery regulations were generally successful in constraining harvest to ceiling levels. Contingent upon stock strength, regulations could be further relaxed in the South Thompson River fishery.

2. The Thompson River (Spences Bridge) sport fishery was an extremely effective harvester of chinook salmon. Because this fishery harvests primarily Nicola River chinook salmon, restrictive regulations should be reimplemented until the decline of Nicola River chinook escapements is halted and a rebuilding trend is established.

Table 5. Estimated chinook adult harvest per unit effort (HPUE), by interview type, in the 1990 Fraser River study areas.

Location	Interview type[a]	Number of interviews	Angler hours	Chinook adult harvest	Chinook adult HPUE[b]
Lower Fraser River, July	Complete trip	509	3,381	23	0.0068
	Combined	551	3,618	25	0.0069
	Previous Trip	400	3,198	23	0.0072
Lower Fraser River, August	Complete trip	247	1,522	18	0.0118
	Combined	374	1,968	18	0.0091
	Previous trip	283	2,038	13	0.0064
Lower Shuswap River	Complete trip	531	2,103	106	0.0504
	Combined	1,121	4,081	160	0.0392
	Previous trip	236	1,463	27	0.0185
South Thompson River	Complete trip	67	227	2	0.0088
	Combined	437	1,116	9	0.0081
	Previous trip	282	1,777	20	0.0113
Thompson River	Complete trip	746	2,375	144	0.0606
	Combined	820	2,537	187	0.0737
Vedder-Chilliwack River, July	Complete trip	30	77	0	0.0000
	Combined	372	722	2	0.0028
Vedder-Chilliwack River, August	Complete trip	11	35	4	0.1159
	Combined	354	987	13	0.0132

[a] Combined indicates complete and incomplete trip interviews
[b] Not weighted by day type or site.

3. The Shuswap River and Mabel Lake sport fishery harvest exceeded the ceiling by three-fold; however, the mechanism for the dramatic increase in fishery performance is not understood. Further intensive monitoring of this fishery is necessary to determine if more restrictive management actions are required.

4. Structured fishery assessment studies should occur in the following areas: lower Fraser and lower Shuswap rivers, due to the high effort and chinook harvest levels; South Thompson River, until fishery performance stabilizes; and Thompson River, an effective fishery which targets on a stock of concern. Further evaluation is also required on the Clearwater River, which has not been monitored since 1986.

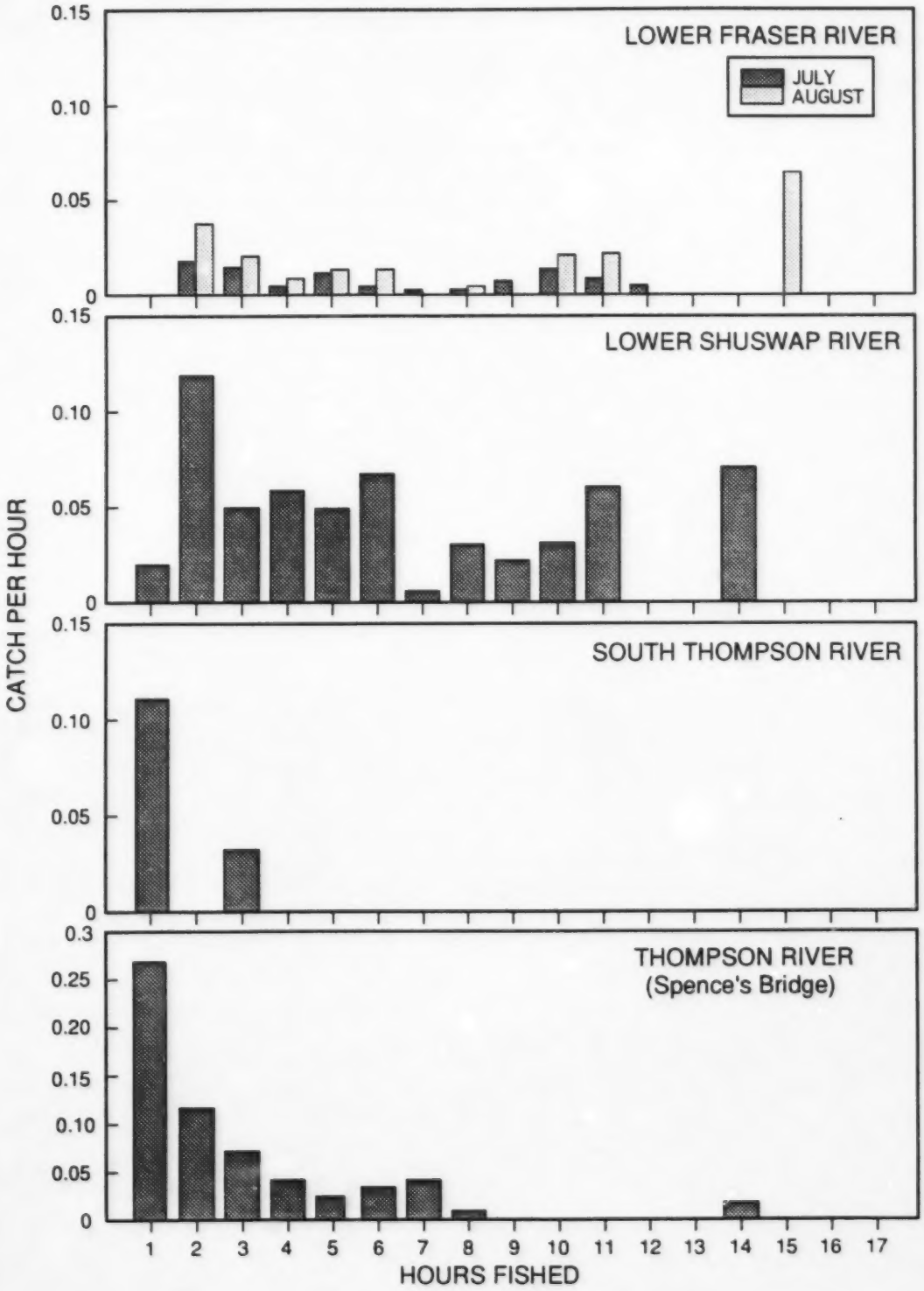


Figure 8. Harvest Per Unit Effort of Chinook Adults, by Trip Duration, in the 1990 Study Area Sport Fisheries.

SUMMARY

1. Sport fishery assessment studies were conducted in the lower Fraser, lower Shuswap, South Thompson, Thompson (Spences Bridge) and Vedder-Chilliwack rivers in 1990. In general, each fishery was managed through restrictions in fishing time, daily and annual angler harvest limits and fishery-specific harvest ceilings. Each fishery was managed in a manner similar to the previous year, except the number of days open increased in the Shuswap (from 21 to 28 days), South Thompson (from 14 to 21 days) and Thompson (from 12 to 33 days) rivers. The Thompson River harvest ceiling increased from 100 to 300 chinook adults, and Mabel Lake opened for the first time. The Vedder-Chilliwack River fishery was opened in 1988; however, 1990 was the first year of assessment.

2. The fisheries were assessed using a complete census (Thompson River), roving (Vedder-Chilliwack River), hybrid (lower Shuswap and South Thompson) or access point-overflight (lower Fraser River) survey.

3. Each fishery was assessed by one to four surveyors, depending on the extent of the open area, expected angler effort and available resources. The surveyors recorded the following information during 4,029 angler interviews: length of time angling, preferred species, number and species of fish harvested or released, identifying marks on harvested fish and gear type. In addition, if the angler had fished the river in the last two weeks, the interviewer recorded harvest and length of time angling on the most recent trip. Lower Shuswap River and Thompson River observed catch was sampled for size, flesh colour, sex, adipose fin status and scales.

4. Study area angler effort was estimated at 107,545 angler hours or 23,033 angler days. Of that total, 60,152 occurred in the lower Fraser River, 28,708 in the lower Shuswap River, 4,227 in the South Thompson River, 2,537 in the Thompson River and 11,921 on Vedder-Chilliwack River. Most anglers targeted on chinook salmon.

5. Study area harvest was estimated at 2,216 chinook adults, 38 chinook jacks, 450 rainbow trout, 136 cutthroat trout, 5 Dolly Varden and 41 sturgeon. Of the chinook adult harvest, 458 were from the lower Fraser River, 1,415 from the lower Shuswap River, 39 from the South Thompson River, 187 from the Thompson River and 117 from the Vedder-Chilliwack River. Eighty-two chinook adults had adipose fin clips, 25 in the lower Shuswap River, 36 in the Thompson River and 21 in Vedder-Chilliwack River.

6. Study area release was estimated at 71 chinook adults, 18 chinook jacks, 32 sockeye salmon and 22 rainbow trout. Chinook adults were released in the the the lower Fraser (6), lower Shuswap (20), South Thompson (8) and Thompson (37) rivers.

7. Chinook adult harvest rates ranged from 0.7% to 12.0%. The highest harvest rates were recorded in the lower Shuswap and Vedder-Chilliwack rivers.

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Appendices

Appendix 1. Interview responses by week at Queen's Island in the July and August 1990 lower Fraser River sport fishery.

	Period ending						Period ending				
	08-Jul	15-Jul	22-Jul	29-Jul	31-Jul	July total	05-Aug	12-Aug	19-Aug	26-Aug	August total
Number of Interviews	39	117	168	206	21	551	164	136	51	23	374
Mean Angler Day Length (hr.)											
- All anglers	7.3	6.2	6.6	7.7	5.6	6.9	6.9	6.4	4.4	5.8	6.3
- Complete trip interviews											
Number	39	116	153	182	19	509	120	79	37	11	247
Hours	7.3	6.1	6.0	7.5	5.5	6.6	7.0	6.0	3.9	6.0	6.2
- Incomplete trip interviews											
Number	0	1	15	24	2	42	44	57	14	12	127
Hours	-	17.0	13.0	9.3	6.0	10.6	6.6	7.0	5.4	5.6	6.6
Mean number of anglers per party	2.3	2.4	2.3	2.5	1.7	2.4	2.3	2.4	1.7	1.6	2.3
Target Species											
- Chinook	39	117	168	202	19	545	163	133	51	23	370
- Coho	-	-	-	-	-	0	-	3	-	-	3
- Cutthroat	-	-	-	-	2	2	1	-	-	-	1
- Sturgeon	-	-	-	4	-	4	-	-	-	-	0
Harvested Catch											
- Chinook adult	1	1	16	7	-	25	13	4	1	-	18
- Chinook jack	-	-	2	1	-	3	-	-	-	-	0
- Cutthroat	-	-	-	-	-	0	5	-	-	-	5
- Sturgeon	-	-	2	-	-	2	-	1	-	-	1
Released Catch											
- Chinook adult	-	-	1	-	-	1	-	-	-	-	0
- Sockeye	-	-	-	3	-	3	-	2	-	-	2
Inspection of Catch											
- Number	0	0	10	0	0	10	10	5	0	0	15
- Number correct	-	-	10	-	-	10	10	5	-	-	15
Gear											
- Bait	-	-	-	6	1	7	-	1	-	-	1
- Lure	23	112	165	200	20	520	161	116	45	17	339
- Bait/Lure	14	5	2	-	-	21	2	19	6	6	33
- Fly	-	-	-	-	-	0	-	-	-	-	0
Previous Lower Fraser River angling a											
- Number	12	88	130	152	18	400	120	105	44	14	283
- Mean angler day (hr)	7.0	8.5	7.6	8.2	7.3	8.0	7.5	7.4	6.2	5.7	7.2
- Harvest											
Chinook	3	-	10	9	1	23	8	2	2	1	13
Chinook jack	-	-	1	-	-	1	-	6	1	-	7
Sturgeon	-	-	-	-	-	0	-	1	-	-	1

a. Within 2 weeks of the interview; data are specific to the most recent trip.

Appendix 2. Daily angler counts in the July and August 1990 lower Fraser River sport fishery.

Month	Date	Day of week	Weather	Mean angler count: Sumas River to Harrison River a	Queen's Island Bar	Harrison River to Agassiz-Rosedale powerline	Total
July	10-Jul	Tue	Sunny	5	9	1	15
	14-Jul	Sat	Sunny	34	48	3	85
	19-Jul	Thu	Sunny	11	45	3	59
	22-Jul	Sun	Sunny	27	73	12	112
	25-Jul	Wed	Overcast	25	55	17	97
	28-Jul	Sat	Sunny	53	75	11	139
	Weekday	Mean	-	14	36	7	57
		%	-	24.0%	63.7%	12.3%	-
	Weekend	Mean	-	38	65	9	112
		%	-	33.9%	58.3%	7.7%	-
August	06-Aug	BCday	Sunny	83	50	18	151
	14-Aug	Tue	Sunny	30	13	8	51
	25-Aug	Sat	Sunny	76	23	3	102
	29-Aug	Wed	Overcast	26	2	4	32
	Weekday	Mean	-	28	8	6	42
		%	-	67.5%	18.1%	14.5%	
	Weekend	Mean	-	80	37	11	127
		%	-	62.8%	28.9%	8.3%	-

a. Excludes Queen's Island Bar.

Appendix 3. Mean hourly proportion of daily angler effort in the 1990 lower Fraser, Shuswap, South Thompson, Thompson (Spences Bridge) and Vedder-Chilliwack sport fisheries.

	Lower Fraser River									Thompson River a		Vedder-Chilliwack River b	
	July		August		Lower Shuswap River			South Thompson River					
Hour	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend	Mabel Lake	Weekday	Weekend	West side	Nicola River mouth	July	August
100	0.000	0.000	0.000	0.000	0.000	0.000	-	0.000	0.001	-	-	-	-
200	0.000	0.000	0.000	0.000	0.000	0.000	-	0.000	0.001	-	-	-	-
300	0.000	0.000	0.000	0.000	0.000	0.000	-	0.000	0.001	-	-	-	-
400	0.000	0.000	0.000	0.000	0.000	0.000	-	0.000	0.001	-	-	-	-
500	0.010	0.007	0.002	0.004	0.056	0.057	0.001	0.032	0.005	-	-	-	-
600	0.027	0.025	0.012	0.017	0.074	0.084	0.015	0.024	0.044	0.118	0.090	-	-
700	0.042	0.044	0.027	0.034	0.067	0.084	0.058	0.076	0.071	0.125	0.116	0.091	0.107
800	0.051	0.049	0.091	0.045	0.075	0.075	0.069	0.131	0.090	0.147	0.125		
900	0.058	0.069	0.059	0.054	0.053	0.061	0.081	0.195	0.074	0.140	0.122	0.279	0.144
1000	0.072	0.075	0.059	0.070	0.035	0.043	0.069	0.072	0.120	0.128	0.109		
1100	0.070	0.079	0.059	0.067	0.038	0.047	0.071	0.060	0.090	0.079	0.099	0.165	0.120
1200	0.069	0.075	0.069	0.062	0.040	0.038	0.069	0.051	0.084	0.048	0.056		
1300	0.062	0.059	0.069	0.059	0.033	0.032	0.066	0.044	0.041	0.029	0.041	0.181	0.170
1400	0.067	0.067	0.070	0.065	0.035	0.034	0.062	0.046	0.053	0.019	0.033		
1500	0.061	0.063	0.064	0.061	0.036	0.039	0.063	0.048	0.067	0.020	0.027	0.080	0.159
1600	0.062	0.064	0.076	0.075	0.040	0.057	0.067	0.020	0.063	0.008	0.014		
1700	0.056	0.059	0.065	0.084	0.047	0.070	0.063	0.048	0.055	0.004	0.020	0.095	0.142
1800	0.069	0.059	0.069	0.075	0.059	0.067	0.065	0.068	0.041	0.020	0.017		
1900	0.065	0.057	0.067	0.075	0.094	0.078	0.092	0.056	0.051	0.026	0.029	0.109	0.159
2000	0.063	0.052	0.057	0.056	0.106	0.075	0.078	0.016	0.031	0.045	0.042	-	-
2100	0.044	0.047	0.039	0.047	0.067	0.037	-	0.016	0.012	0.044	0.059	-	-
2200	0.044	0.046	0.035	0.051	0.029	0.013	-	0.000	0.001	-	-	-	-
2300	0.006	0.005	0.008	0.000	0.013	0.006	-	0.000	0.001	-	-	-	-
2400	0.000	0.000	0.003	0.000	0.005	0.002	-	0.000	0.000	-	-	-	-

a. Fishery was open 6 a.m. to 9 p.m.
b. Midpoint of two-hour time block.

Appendix 4. Daily catch (harvest and release) per angler hour at Queen's Island in the July and August 1990 lower Fraser River sport fishery.

July					August				
Date	Chinook adult	Chinook jack	Sockeye	Sturgeon	Date	Chinook adult	Sockeye	Cut-throat	Stur-geon
07-Jul	0.0104	0.0000	0.0000	0.0000	02-Aug	0.0129	0.0000	0.0000	0.0000
08-Jul	0.0000	0.0000	0.0000	0.0000	03-Aug	0.0286	0.0000	0.0000	0.0000
09-Jul	0.0000	0.0000	0.0000	0.0000	04-Aug	0.0092	0.0000	0.0115	0.0000
10-Jul	0.0000	0.0000	0.0000	0.0000	05-Aug	0.0103	0.0000	0.0000	0.0000
13-Jul	0.0000	0.0000	0.0000	0.0000	08-Aug	0.0000	0.0000	0.0000	0.0000
14-Jul	0.0000	0.0000	0.0000	0.0000	09-Aug	0.0000	0.0000	0.0000	0.0000
15-Jul	0.0029	0.0000	0.0000	0.0000	10-Aug	0.0222	0.0000	0.0000	0.0000
16-Jul	0.0494	0.0000	0.0000	0.0000	11-Aug	0.0000	0.0231	0.0000	0.0000
19-Jul	0.0093	0.0000	0.0000	0.0047	12-Aug	0.0045	0.0000	0.0000	0.0045
20-Jul	0.0215	0.0108	0.0000	0.0000	15-Aug	0.0000	0.0000	0.0000	0.0000
21-Jul	0.0125	0.0000	0.0000	0.0000	16-Aug	0.0000	0.0000	0.0000	0.0000
22-Jul	0.0191	0.0024	0.0000	0.0024	17-Aug	0.0000	0.0000	0.0000	0.0000
25-Jul	0.0000	0.0000	0.0000	0.0000	18-Aug	0.0000	0.0000	0.0000	0.0000
26-Jul	0.0127	0.0063	0.0000	0.0000	19-Aug	0.0488	0.0000	0.0000	0.0000
27-Jul	0.0049	0.0000	0.0000	0.0000	24-Aug	0.0000	0.0000	0.0000	0.0000
28-Jul	0.0081	0.0000	0.0000	0.0000	25-Aug	0.0000	0.0000	0.0000	0.0000
29-Jul	0.0000	0.0000	0.0064	0.0000	26-Aug	0.0000	0.0000	0.0000	0.0000
30-Jul	0.0000	0.0000	0.0000	0.0000					
Total a									
HPUE	0.0068	0.0009	0.0000	0.0005		0.0083	0.0000	0.0042	0.0008
RPUE	0.0002	0.0000	0.0005	0.0000		0.0000	0.0006	0.0000	0.0000
Combined	0.0070	0.0009	0.0005	0.0005		0.0083	0.0006	0.0042	0.0008

a. Weighted; see methods.

Appendix 5a. Interview responses by week at Chuck's Pool in the 1990 lower Shuswap River sport fishery.

	Week ending					
	19-Aug	26-Aug	02-Sep	09-Sep	16-Sep	Total
Number of interviews	71	103	99	98	39	410
Mean Angler Day Length (hr.)						
- All anglers	5.6	4.0	4.5	6.1	3.7	4.9
- Complete trip interviews						
Number	24	69	56	51	32	232
Hours	2.9	3.3	3.0	4.3	3.1	3.4
- Incomplete trip interviews						
Number	47	34	43	47	7	178
Hours	6.9	5.5	6.4	8.1	6.3	6.8
Mean number of anglers per party	2.3	1.7	1.8	2.3	1.8	2.0
Target Species						
- Chinook	71	103	98	96	38	406
- Rainbow	-	-	-	2	1	3
- Anything	-	-	1	-	-	1
Harvested Catch						
- Chinook adult	5	13	24	16	13	71
- Chinook jack	-	-	1	-	-	1
Released Catch						
- Chinook adult	-	-	-	1	-	1
- Chinook jack	-	-	-	-	1	1
Inspection of Catch						
- Number	5	1	14	12	13	45
- Number correct	5	1	14	12	13	45
Gear						
- Bait	17	1	29	45	23	115
- Lure	38	77	52	32	6	205
- Bait/Lure	16	24	18	21	10	89
- Fly	-	-	-	-	-	-

Appendix 5b. Interview responses by week at Log Dump Pool in the 1990 lower Shuswap River sport fishery.

	Week ending					
	19-Aug	26-Aug	02-Sep	09-Sep	16-Sep	Total
Number of interviews	54	79	107	97	35	372
Mean Angler Day Length (hr.):						
- All anglers	3.8	5.4	5.4	5.4	5.4	5.2
- Complete trip interviews						
Number	27	41	74	72	18	232
Hours	3.3	5.0	4.5	4.9	4.1	4.5
- Incomplete trip interviews						
Number	27	38	33	25	17	140
Hours	4.4	5.8	7.6	6.9	6.7	6.3
Mean number of anglers per party	1.9	2.0	2.3	1.6	2.5	2.0
Target Species						
- Chinook	51	79	103	97	35	365
- Rainbow	2	-	1	-	-	3
- Anything	1	-	3	-	-	4
Harvested Catch						
- Chinook adult	1	2	15	31	6	55
- Chinook adult, adipose clipped	-	-	2	-	-	2
Released Catch						
- Chinook adult	-	-	-	2	-	2
- Chinook jack	-	-	1	-	-	1
Inspection of Catch						
- Number	1	1	7	23	1	33
- Number correct	1	1	7	23	1	33
Gear						
- Bait	11	5	16	20	2	54
- Lure	34	50	68	55	30	237
- Bait/Lure	6	22	21	22	3	74
- Fly	2	-	1	-	-	3

Appendix 5c. Interview responses by week in the roving survey of the 1990 lower Shuswap River sport fishery.

	Week ending					
	19-Aug	26-Aug	02-Sep	09-Sep	16-Sep	Total
Number of Interviews	33	82	124	77	23	339
Mean Angler Day Length (hr.)						
- All anglers	5.3	5.5	6.9	6.5	5.7	6.2
- Complete trip interviews						
Number	1	18	15	21	12	67
Hours	2.0	3.0	3.4	4.8	4.4	3.9
- Incomplete trip interviews						
Number	32	64	109	56	11	272
Hours	5.4	6.2	7.4	7.1	7.0	6.8
Mean number of anglers per party	1.5	2.1	2.0	2.0	1.5	1.9
Target Species						
- Chinook	33	81	122	76	23	335
- Rainbow	-	1	1	1	-	3
- Whitefish	-	-	1	-	-	1
Harvested Catch						
- Chinook adult	1	3	12	10	6	32
- Rainbow b	-	-	2	1	-	3
- Squawfish b	-	-	-	-	1	1
- Whitefish b	-	-	4	-	-	4
Released Catch						
- Chinook adult	-	-	-	1	-	1
- Rainbow b	-	1	1	-	-	2
- Squawfish b	-	-	-	2	6	8
Inspection of Catch						
- Number	0	0	9	4	2	15
- Number correct	-	-	9	4	2	15
Gear						
- Bait	9	18	25	28	10	90
- Lure	19	20	68	28	4	139
- Bait/Lure	5	44	30	19	9	107
- Fly	-	-	1	1	-	2
Previous Lower Shuswap River Angling a						
- No. who fished chinook previously	16	46	98	56	20	236
- Mean angler day length	4.6	5.5	7.3	6.0	5.3	6.2
- Harvest						
Chinook	-	2	9	10	6	27

a. Within 2 weeks of the interview; data are specific to the most recent trip.
b. All observed catch was from incomplete trip interviews; total catch was not calculated due to incomplete trip interview bias.

Appendix 6a. Daily angler counts by area in the Mara Lake to Ashton Creek section of the 1990 lower Shuswap River sport fishery.

Date	Day of week	Time	Mara Lake to Ashton Creek Bridge a				
			1	2	3 b	4	Total
16 Aug	Thu	0557-0642	0	3	9	0	12
17 Aug	Fri	1905-2014	0	5	10	1	16
18 Aug	Sat	1900-2000	0	7	19	0	26
19 Aug	Sun	0656-0741	0	11	11	2	24
20 Aug	Mon	0618-0655	0	1	10	0	11
23 Aug	Thu	1919-1959	0	26	27	8	61
24 Aug	Fri	1829-1908	0	19	22	4	45
25 Aug	Sat	0615-0711	0	11	10	2	23
26 Aug	Sun	1850-1930	0	15	26	2	43
27 Aug	Mon	0636-0714	0	5	17	2	24
30 Aug	Thu	0601-0641	0	5	4	2	11
31 Aug	Fri	1917-1952	0	30	22	6	58
01 Sep	Sat	1904-1944	0	19	21	2	42
02 Sep	Sun	0551-0633	0	1	16	6	23
03 Sep	Mon	1937-2018	0	32	20	6	58
07 Sep	Fri	1828-1949	0	12	14	7	33
08 Sep	Sat	1835-1918	0	22	6	3	31
09 Sep	Sun	0655-0739	0	12	4	3	19
11 Sep	Tue	1938-2008	0	16	7	0	23
Weekday	a.m.	Mean	0	4	10	1	15
	shift	% c	0.0%	8.3%	23.7%	2.4%	34.3%
	p.m.	Mean	0	17	15	4	37
	shift	% c	0.0%	18.4%	16.4%	4.5%	39.2%
Weekend	a.m.	Mean	0	9	10	3	22
	shift	% c	0.0%	10.3%	12.1%	3.8%	26.2%
	p.m.	Mean	0	19	18	3	40
	shift	% c	0.0%	20.3%	19.6%	2.8%	42.6%

a. Areas were: 1 - Mara Lake to Mara Bridge.
2 - Mara Bridge to Grinrod Bridge.
3 - Grinrod Bridge to Enderby Bridge.
4 - Enderby Bridge to Ashton Creek Bridge.

b. Includes Enderby Bridge site.

c. Total includes counts in the river between Ashton Creek to Mabel Lake; see Appendix 6b.

Appendix 6b. Daily angler counts by area in the Ashton Creek to Mabel Lake section of the 1990 lower Shuswap River sport fishery.

Date	Day of week	Time	Ashton Creek Bridge to Mable Lake a						Lower Shuswap River total d
			1	2 b	3	4	5 c	Total	
16 Aug	Thu	0557-0642	9	6	0	0	15	30	42
17 Aug	Fri	1905-2014	5	14	0	0	10	29	45
18 Aug	Sat	1900-2000	8	26	0	0	17	51	77
19 Aug	Sun	0656-0741	4	12	0	1	17	34	58
20 Aug	Mon	0618-0655	2	8	0	0	13	23	34
23 Aug	Thu	1919-1959	3	14	0	4	19	40	101
24 Aug	Fri	1829-1908	8	17	2	4	19	50	95
25 Aug	Sat	0615-0711	9	14	4	4	15	46	69
26 Aug	Sun	1850-1930	7	11	0	3	15	36	79
27 Aug	Mon	0636-0714	2	13	0	1	15	31	55
30 Aug	Thu	0601-0641	3	7	0	0	17	27	38
31 Aug	Fri	1917-1952	1	22	0	4	20	47	105
01 Sep	Sat	1904-1944	2	22	2	3	34	63	105
02 Sep	Sun	0551-0633	8	33	4	3	50	98	121
03 Sep	Mon	1937-2018	14	21	0	3	17	55	113
07 Sep	Fri	1828-1949	9	27	3	0	32	71	104
08 Sep	Sat	1835-1918	6	26	2	3	27	64	95
09 Sep	Sun	0655-0739	5	15	5	0	48	73	92
11 Sep	Tue	1938-2008	11	29	8	0	40	88	111
Weekday	a.m.	Mean	4	9	0	0	15	28	42
	shift	% c	9.5%	20.1%	0.0%	0.6%	35.5%	65.7%	-
	p.m.	Mean	6	21	2	2	23	54	94
	shift	% c	6.6%	21.9%	2.3%	2.1%	25.0%	57.9%	-
Weekend	a.m.	Mean	7	19	3	2	33	63	85
	shift	% c	7.6%	21.8%	3.8%	2.4%	38.2%	73.8%	-
	p.m.	Mean	7	21	1	2	22	54	94
	shift	% c	7.9%	22.6%	0.9%	2.6%	23.5%	57.4%	-

a. Areas were: 1 - Ashton Creek Bridge to Fall Creek.
2 - Fall Creek to Cooke Creek.
3 - Cooke Creek to Delorne Creek.
4 - Delorne Creek to Skookumchuck.
5 - Skookumchuck to Mabel Lake.

b. Includes Log Dump Pool site.

c. Includes Chuck's Pool site.

d. Total includes counts in the river between Ashton Creek to Mabel Lake; see Appendix 6a.

Appendix 7. Daily catch (harvest and release) per angler hour in the 1990 lower Shuswap River sport fishery.

	Chuck's Pool		Log Dump Pool		Roving survey
Date	Chinook adult	Chinook jack	Chinook adult	Chinook jack	Chinook adult
16-Aug	0.0160	0.0000	0.0000	0.0000	0.0000
17-Aug	0.0000	0.0000	0.0000	0.0000	0.0000
18-Aug	0.0000	0.0000	0.0000	0.0000	0.0194
19-Aug	0.0523	0.0000	0.0220	0.0000	0.0000
20-Aug	0.0417	0.0000	0.0000	0.0000	0.0000
23-Aug	0.0206	0.0000	0.0000	0.0000	0.0000
24-Aug	0.0656	0.0000	0.0000	0.0000	0.0000
25-Aug	0.0645	0.0000	0.0165	0.0000	0.0385
26-Aug	0.0165	0.0000	0.0081	0.0000	0.0272
27-Aug	0.1186	0.0000	0.0606	0.0000	0.0299
30-Aug	0.2500	0.0000	0.0000	0.0000	0.0825
31-Aug	0.0328	0.0000	0.0108	0.0000	0.0229
01-Sep	0.1319	0.0000	0.0546	0.0055	0.0232
02-Sep	0.0170	0.0085	0.0440	0.0000	0.0377
03-Sep	0.1026	0.0000	0.0853	0.0000	0.0000
04-Sep	0.0000	0.0000	0.0517	0.0000	0.0000
07-Sep	0.0299	0.0000	0.0613	0.0000	0.0315
08-Sep	0.0000	0.0000	0.0690	0.0000	0.0658
09-Sep	0.0380	0.0000	0.0000	0.0000	0.0510
10-Sep	0.0545	0.0000	0.0000	0.0000	0.0000
11-Sep	0.0000	0.0238	0.0476	0.0000	0.0667
Total					
HPUE	0.0482	0.0007	0.0368	0.0000	0.0293
RPUE	0.0007	0.0007	0.0013	0.0007	0.0009
Combined	0.0489	0.0014	0.0381	0.0007	0.0302

Appendix 8. Mean nose-fork length and weight, by flesh colour, age and sex of chinook salmon harvested in the 1990 lower Shuswap River sport fishery.

Flesh Colour	Sex	Age	Sample Size	%	Mean length (cm)	Mean weight (kg)
Red	Male	5/2	0	0.0%	-	-
		4/2	1	9.1%	88.0	8.2
		4/1	10	90.9%	89.0	8.2
		3/1	0	0.0%	-	-
		Unknown	3	-	94.7	10.1
		Total	14	-	90.2	8.6
	Female	5/2	2	7.7%	84.0	7.0
		4/2	0	0.0%	-	-
		4/1	23	88.5%	84.2	7.2
		3/1	1	3.8%	86.0	8.2
		Unknown	16	-	86.0	8.0
		Total	42	-	84.9	7.5
	Total	5/2	2	5.4%	84.0	7.0
		4/2	1	2.7%	88.0	8.2
		4/1	33	89.2%	85.6	7.5
		3/1	1	2.7%	86.0	8.2
		Unknown	19	-	87.4	8.3
		Total	56	-	86.2	7.8

Appendix 9a. Interview responses by week at Rocky Point in the 1990 South Thompson River sport fishery.

	Week ending				
	02-Sep	09-Sep	16-Sep	23-Sep	Total
Number of interviews	91	82	53	27	253
Mean Angler Day Length (hr.)					
- All anglers	5.9	6.0	6.2	5.3	5.9
- Complete trip interviews					
Number	13	14	15	6	48
Hours	2.5	2.5	4.0	4.3	3.2
- Incomplete trip interviews					
Number	78	68	38	21	205
Hours	6.5	6.7	7.0	5.6	6.6
Mean number of anglers per party	1.9	2.0	1.9	1.9	1.9
Target Species					
- Chinook	85	79	52	27	243
- Steelhead	1	-	-	-	1
- Rainbow	4	3	1	-	8
- Anything	1	-	-	-	1
Harvested Catch					
- Chinook adult	2	2	4	-	8
- Chinook jack	-	-	1	-	1
Released Catch					
- Rainbow	2	2	-	-	4
Inspection of Catch					
- Number	1	2	2	0	5
- Number correct	1	2	2	-	5
Gear					
- Bait	12	2	6	-	20
- Lure	68	79	42	27	216
- Bait/Lure	6	1	5	-	12
- Fly	5	-	-	-	5
Previous South Thompson River angling a					
- No. who fished chinook previously	40	35	35	23	133
- Mean angler day length	5.8	6.9	7.0	5.3	6.3
- Harvest:					
Chinook	3	2	5	1	11
Chinook jack	-	-	2	2	4

a. Within 2 weeks of the interview; data are specific to the most recent trip.

Appendix 9b. Interview responses by week in the roving survey of the 1990 South Thompson River sport fishery.

	Week ending				
	02-Sep	09-Sep	16-Sep	23-Sep	Total
Number of interviews	72	85	16	11	184
Mean Angler Day Length (hr.)					
- All anglers	4.6	6.5	4.7	6.3	5.6
- Complete trip interviews					
Number	9	6	3	1	19
Hours	3.0	3.8	5.7	6.5	3.2
- Incomplete trip interviews					
Number	63	79	13	10	165
Hours	4.8	6.7	4.5	6.3	5.8
Mean number of anglers per party	2.0	2.0	1.4	1.6	1.9
Target Species					
- Chinook	62	82	13	10	167
- Rainbow	10	3	3	1	17
- Anything	-	-	-	-	0
Harvested Catch					
- Chinook adult	-	-	1	-	1
- Rainbow	1	-	2	-	3
Released Catch					
- Chinook adult	-	1	-	-	1
- Rainbow	-	-	2	-	2
Inspection of Catch					
- Number	0	0	1	0	1
- Number correct	-	-	1	-	1
Gear					
- Bait	2	1	3	1	7
- Lure	64	76	13	10	163
- Bait/Lure	3	8	-	-	11
- Fly	2	-	-	-	2
Previous South Thompson River angling a					
- No. who fished chinook previously	41	70	29	9	149
- Mean angler day length	5.9	6.6	5.4	8.4	6.3
- Harvest:					
Chinook	3	2	2	2	9

a. Within 2 weeks of the interview; data are specific to the most recent trip.

Appendix 10. Daily angler counts by area in the 1990 South Thompson River sport fishery.

Date	Day of week	Time	Area a				Total
			1	2	3 b	4	
31-Aug	Fri	1300-1400	2	0	13	10	25
01-Sep	Sat	1300-1400	10	0	13	12	35
02-Sep	Sun	1300-1400	4	2	18	20	44
03-Sep	Mon	1300-1400	9	5	21	15	50
06-Sep	Thu	1300-1400	0	0	16	14	30
07-Sep	Fri	1300-1400	2	0	9	7	18
08-Sep	Sat	1300-1400	4	0	34	17	55
09-Sep	Sun	1300-1400	7	2	5	3	17
10-Sep	Mon	1300-1400	3	0	8	6	17
11-Sep	Tue	1300-1400	2	0	7	2	11
14-Sep	Thu	1300-1400	2	2	3	5	12
15-Sep	Fri	1300-1400	2	0	11	4	17
16-Sep	Sat	1300-1400	6	0	6	4	16
17-Sep	Sun	1300-1400	3	0	3	7	13
18-Sep	Mon	1300-1400	0	3	8	2	13
Weekday	Mean	-	2	1	9	6	18
	%	-	9.1%	3.5%	52.4%	35.0%	-
Weekend	Mean	-	6	1	14	11	33
	%	-	18.7%	3.9%	43.5%	33.9%	-

a. Areas were: 1 - Chase to Shuswap.
2 - Shuswap to Niskanlith Creek.
3 - Niskanlith Creek to the bluffs.
4 - Bluffs to Pritchard.

b. Includes Rocky Point site.

Appendix 11. Daily catch (harvest and release) per angler hour in the 1990 South Thompson River sport fishery.

	Rocky Point			Roving Survey	
Date	Chinook adult	Chinook jack	Rainbow	Chinook adult	Rainbow
30-Aug	0.0755	0.0000	0.0000	0.0000	0.0408
31-Aug	0.0000	0.0000	0.0317	0.0000	0.0000
01-Sep	0.0000	0.0000	0.0000	0.0000	0.0000
02-Sep	0.0000	0.0000	0.0000	0.0000	0.0000
03-Sep	0.0000	0.0000	0.0106	0.0000	0.0000
06-Sep	0.0213	0.0000	0.0000	0.0308	0.0000
07-Sep	0.0000	0.0000	0.0714	0.0000	0.0000
08-Sep	0.0119	0.0000	0.0000	0.0000	0.0000
09-Sep	0.0000	0.0000	0.0000	0.0000	0.0000
11-Sep	0.0000	0.0000	0.0000	0.0000	0.0000
14-Sep	0.0488	0.0000	0.0000	0.0000	0.0000
15-Sep	0.0482	0.0120	0.0000	0.0000	0.1429
16-Sep	0.0000	0.0000	0.0000	0.0357	0.0000
17-Sep	0.0000	0.0000	0.0000	0.0000	0.0000
18-Sep	0.0000	0.0000	0.0000	0.0000	0.0000
Total					
HPUE	0.0113	0.0014	0.0000	0.0025	0.0074
RPUE	0.0000	0.0000	0.0056	0.0025	0.0049
Combined	0.0113	0.0014	0.0056	0.0050	0.0123

Appendix 12a. Interview responses by week on the east bank (Nicola River mouth) in the 1990 Thompson River (Spences Bridge) sport fishery.

	Week ending									
	09-Jul	16-Jul	23-Jul	30-Jul	06-Aug	13-Aug	20-Aug	27-Aug	03-Sep	Total
Number of Interviews	20	48	77	118	131	100	70	35	5	604
Mean Angler Day Length (hr.)										
- All anglers	2.5	2.8	3.4	4.0	3.8	3.6	2.8	3.6	0.9	3.5
- Complete trip interviews										
Number	17	47	63	90	119	99	69	35	5	544
Hours	1.6	2.7	3.4	3.4	3.6	3.6	2.8	3.6	0.9	3.3
- Incomplete trip interviews										
Number	3	1	14	28	12	1	1	0	0	60
Hours	7.7	6.0	3.7	5.8	5.5	8.0	4.5	-	-	5.3
Mean number of anglers in party	1.6	2.2	2.4	2.4	2.2	2	2.1	2.3	1.8	2.2
Target Species										
- Chinook	20	48	77	113	131	100	70	33	5	597
- Rainbow	-	-	-	5	-	-	-	2	-	7
Harvested Catch										
- Chinook adult	-	4	17	34	30	16	7	-	-	108
- Chinook adult, adipose clip	-	1	3	14	7	2	1	-	-	28
- Chinook jack	-	-	-	2	1	1	-	-	-	4
- Chinook jack, adipose clip	-	-	-	-	1	-	-	-	-	1
- Rainbow	-	1	-	-	-	-	-	2	-	3
Released Catch										
- Chinook adult	1	2	3	11	2	8	-	-	-	27
- Chinook jack	-	-	-	-	-	-	1	-	-	1
Inspection of Catch										
- Number	0	6	17	24	16	16	6	0	0	85
- Number correct	-	6	17	24	16	16	6	-	-	85
Gear										
- Bait	6	26	53	90	102	80	53	23	2	435
- Lure	5	18	12	19	15	12	12	3	-	96
- Bait/Lure	9	4	11	8	14	8	4	6	3	67
- Fly	-	-	-	-	-	-	1	3	-	4

Appendix 12b. Interview responses by week on the west bank in the 1990 Thompson River (Spences Bridge) sport fishery.

	Week ending								
	16-Jul	23-Jul	30-Jul	06-Aug	13-Aug	20-Aug	27-Aug	03-Sep	Total
Number of Interviews	10	22	40	67	51	15	11	0	216
Mean Angler Day Length (hr.)									
- All anglers	2.0	2.9	3.3	3.2	3.1	3.3	1.9	-	3.0
- Complete trip interviews									
Number	10	17	35	65	51	13	11	0	202
Hours	2.0	2.5	2.9	3.1	3.1	3.3	1.9	-	2.9
- Incomplete trip interviews									
Number	0	5	5	2	0	2	0	0	14
Hours	-	4.1	6.0	6.0	-	3.0	-	-	4.9
Mean number of anglers per party	2.0	1.8	2.5	2.5	2.2	1.6	2.5	-	2.3
Target Species									
- Chinook	10	22	40	67	51	15	11	-	216
Harvested Catch									
- Chinook adult	-	1	12	18	12	-	-	-	43
- Chinook adult, adipose clipped	-	-	2	3	3	-	-	-	8
- Chinook jack	-	-	-	-	-	-	1	-	1
- Rainbow	-	-	-	-	-	1	-	-	1
Released Catch									
- Chinook adult	-	-	2	5	3	-	-	-	10
Inspection of Catch									
- Number	0	0	9	18	6	0	0	0	33
- Number correct	-	-	9	18	6	-	-	-	33
Gear									
- Bait	7	16	37	62	48	9	11	-	190
- Lure	2	2	3	5	3	-	-	-	15
- Bait/Lure	1	4	-	-	-	6	-	-	11

Appendix 13. Daily catch (harvest and release) per angler hour in the 1990 Thompson River (Spences Bridge) sport fishery.

	East Bank (Nicola River)			West Bank		
Date	Chinook adult	Chinook jack	Rainbow trout	Chinook	Chinook jack	Rainbow trout
07-Jul	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
08-Jul	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
09-Jul	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
14-Jul	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
15-Jul	0.1077	0.0000	0.0154	0.0000	0.0000	0.0000
16-Jul	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
21-Jul	0.0667	0.0000	0.0000	0.0488	0.0000	0.0000
22-Jul	0.0680	0.0000	0.0000	0.0000	0.0000	0.0000
23-Jul	0.2273	0.0000	0.0000	0.0000	0.0000	0.0000
28-Jul	0.2283	0.0079	0.0000	0.2083	0.0000	0.0000
29-Jul	0.1299	0.0065	0.0000	0.0811	0.0000	0.0000
30-Jul	0.1124	0.0000	0.0000	0.1071	0.0000	0.0000
04-Aug	0.2471	0.0118	0.0000	0.1667	0.0000	0.0000
05-Aug	0.0498	0.0050	0.0000	0.1286	0.0000	0.0000
06-Aug	0.0446	0.0000	0.0000	0.0684	0.0000	0.0000
11-Aug	0.0892	0.0000	0.0000	0.1714	0.0000	0.0000
12-Aug	0.0778	0.0082	0.0000	0.0480	0.0000	0.0000
13-Aug	0.0263	0.0000	0.0000	0.0000	0.0000	0.0000
18-Aug	0.0500	0.0100	0.0000	0.0000	0.0000	0.0000
19-Aug	0.0556	0.0000	0.0000	0.0000	0.0000	0.0000
20-Aug	0.0000	0.0000	0.0000	0.0000	0.0000	0.0435
25-Aug	0.0000	0.0000	0.0242	0.0000	0.0000	0.0000
26-Aug	0.0000	0.0000	0.0000	0.0000	0.0769	0.0000
27-Aug	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
01-Sep	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total						
HPUE	0.0707	0.0031	0.0013	0.0833	0.0016	0.0016
RPUE	0.0140	0.0005	0.0000	0.0163	0.0000	0.0000
Combined	0.0847	0.0036	0.0013	0.0996	0.0016	0.0016

Appendix 14. Mean nose-fork length and weight, by flesh colour, age and sex, of chinook salmon harvested in the 1990 Thompson River (Spences Bridge) sport fishery.

			Male				Female				Total			
Date	Flesh colour	Age	No.	%	Mean Length (cm)	Mean weight (kg)	No.	%	Mean Length (cm)	Mean weight (kg)	No.	%	Mean Length (cm)	Mean weight (kg)
14-Jul	Red	5/2	0	0.0%	-	-	1	100.0%	85.0	6.4	1	33.3%	85.0	6.4
		3/1	2	100.0%	61.5	2.3	0	0.0%	-	-	2	66.7%	61.5	2.3
		Unknown	0	-	-	-	2	-	76.0	4.5	2	-	76.0	4.5
		Total	2	-	61.5	2.3	3	-	79.0	5.2	5	-	72.0	4.0
21-Jul	Red	4/2	2	66.7%	62.5	2.5	3	100.0%	66.0	3.3	5	83.3%	64.8	3.0
		3/1	1	33.3%	65.5	2.7	0	0.0%	-	-	1	16.7%	65.5	2.7
		Unknown	2	-	66.5	3.2	1	-	70.0	3.6	3	-	67.7	3.3
		Total	5	-	64.9	2.8	4	-	67.0	3.4	9	-	66.0	3.1
22-Jul	Red	4/2	1	100.0%	75.0	4.1	1	100.0%	64.0	2.7	2	100.0%	69.5	3.4
		Unknown	0	-	-	-	1	-	56.0	1.4	1	-	56.0	1.4
		Total	1	-	75.0	4.1	2	-	60.0	2.0	3	-	65.0	2.7
23-Jul	Red	4/2	4	80.0%	67.8	3.3	0	0.0%	-	-	4	66.7%	67.8	3.3
		4/1	0	0.0	-	-	1	100.0%	65.0	2.7	1	16.7%	65.0	2.7
		3/1	1	20.0%	67.0	3.6	0	0.0%	-	-	1	16.7%	67.0	3.6
		Unknown	1	-	75.0	4.5	2	-	62.5	2.5	3	-	66.7	3.2
		Total	6	-	68.8	3.6	3	-	63.3	2.6	9	-	68.4	3.5
28-Jul	Red	5/2	3	21.4%	84.6	6.9	2	20.0%	86.0	6.6	5	20.8%	85.2	6.8
		4/2	10	71.4%	73.0	4.4	7	70.0%	66.6	3.2	17	70.8%	70.4	3.8
		3/1	1	7.2%	71.0	3.6	1	10.0%	62.0	2.7	2	8.4%	66.5	3.2
		Unknown	3	-	69.0	4.1	5	-	69.4	3.7	8	-	69.3	3.8
		Total	17	-	74.2	4.7	15	-	69.8	3.8	32	-	72.1	4.3
29-Jul	Red	5/2	0	0.0%	-	-	1	9.1%	79.0	5.5	1	5.9%	79.0	5.5
		4/2	4	66.7%	74.5	4.6	7	63.6%	69.0	3.7	11	64.7%	71.0	4.0
		4/1	1	16.7%	68.0	3.6	2	18.1%	75.0	4.8	3	17.6%	72.3	4.4
		3/1	1	16.7%	62.0	2.3	1	9.1%	62.0	2.7	2	11.8%	62.0	2.5
		Unknown	0	-	-	-	1	-	80.0	5.5	1	-	80.0	5.5
		Total	6	-	71.3	4.1	12	-	71.2	4.1	18	-	71.2	4.1
30-Jul	Red	4/2	2	66.7%	67.0	3.6	2	100.0%	71.0	3.9	4	80.0%	69.0	3.8
		3/1	1	33.3%	70.0	3.6	0	0.0%	-	-	1	20.0%	70.0	3.6
		Unknown	5	-	67.4	3.9	2	-	66.0	2.7	7	-	67.0	3.6
		Total	8	-	67.6	3.8	4	-	68.5	3.3	12	-	67.9	3.7
04-Aug	Red	5/2	5	41.7%	86.0	7.1	5	38.5%	78.4	4.5	10	40.0%	82.2	5.8
		4/2	4	33.3%	73.2	4.4	7	53.8%	68.6	3.9	11	44.0%	70.4	4.1
		4/1	1	8.3%	83.0	6.8	0	0.0%	-	-	1	4.0%	83.0	6.8
		3/1	2	16.7%	69.0	3.2	1	7.6%	67.0	3.6	3	12.0%	68.3	3.3
		Unknown	2	-	77.0	4.3	5	-	71.8	4.4	7	-	73.3	4.4
		Total	14	-	78.4	5.4	18	-	72.2	4.2	32	-	74.9	4.7

Continued

Appendix 14. Mean nose-fork length and weight, by flesh colour, age and sex, of chinook salmon harvested in the 1990 Thompson River (Spences Bridge) sport fishery, continued.

			Male				Female				Total			
Date	Flesh colour	Age	No.	%	Mean Length (cm)	Mean weight (kg)	No.	%	Mean Length (cm)	Mean weight (kg)	No.	%	Mean Length (cm)	Mean weight (kg)
05-Aug	Red	5/2	0	0.0%	-	-	1	10.0%	80.0	5.4	1	8.3%	80.0	5.4
		4/2	2	100.0%	75.5	3.9	7	70.0%	65.4	3.7	9	75.0%	67.6	3.7
		4/1	0	0.0%	-	-	1	10.0%	77.0	5.0	1	8.3%	77.0	5.0
		3/1	0	0.0%	-	-	1	10.0%	79.0	5.0	1	8.3%	79.0	5.0
		Unknown	3	-	64.7	3.2	2	-	77.0	4.5	5	-	69.6	3.7
		Total	5	-	69.0	3.5	12	-	70.7	4.2	17	-	70.1	3.9
06-Aug	Red	5/2	3	100.0%	83.0	6.1	0	0.0%	-	-	3	50.0%	83.0	6.1
		4/2	0	0.0%	-	-	2	67.6%	69.5	3.9	2	33.3%	69.5	3.9
		3/1	0	0.0%	-	-	1	33.3%	76.0	4.5	1	16.7%	76.0	4.5
		Unknown	1	-	82.0	5.9	2	-	75.0	4.1	3	-	77.3	4.7
		Total	4	-	82.8	6.0	5	-	73.0	4.1	9	-	77.4	4.9
11-Aug	Red	5/2	0	0.0%	-	-	3	37.5%	76.7	4.5	3	20.0%	76.7	4.5
		4/2	5	71.4%	75.6	4.5	5	62.5%	67.6	3.2	10	66.7%	71.6	3.8
		4/1	1	14.3%	77.0	4.5	0	0.0%	-	-	1	6.7%	77.0	4.5
		3/1	1	14.3%	68.0	2.7	0	0.0%	-	-	1	6.7%	68.0	2.7
		Unknown	4	-	74.5	4.5	2	-	77.5	4.5	6	-	75.5	4.5
		Total	11	-	74.6	4.3	10	-	72.3	3.8	21	-	73.5	4.1
12-Aug	Red	4/2	4	100.0%	69.0	3.1	2	67.7%	67.5	2.7	6	85.7%	68.5	3.0
		3/1	0	0.0%	-	-	1	33.3%	67.0	2.7	1	14.3%	67.0	2.7
		Unknown	2	-	65.0	3.0	2	-	75.5	4.1	4	-	70.2	3.5
		Total	6	-	67.7	3.1	5	-	70.6	3.3	11	-	69.0	3.2
13-Aug	Red	Unknown	0	-	-	-	1	-	69.0	2.7	1	-	69.0	2.7
		Total	0	-	-	-	1	-	69.0	2.7	1	-	69.0	2.7
18-Aug	Red	4/2	0	-	-	-	5	100.0%	70.8	3.3	5	100.0%	70.8	3.3
		Unknown	0	-	-	-	1	-	65.0	3.2	1	-	65.0	3.2
		Total	0	-	-	-	6	-	69.8	3.3	6	-	69.8	3.3
19-Aug	Red	5/2	1	50.0%	92.0	8.2	0	-	-	-	1	50.0%	92.0	8.2
		4/2	1	50.0%	76.0	3.6	0	-	-	-	1	50.0%	76.0	3.6
		Unknown	1	-	76.0	3.6	0	-	-	-	1	-	76.0	3.6
		Total	3	-	81.3	5.1	0	-	-	-	3	-	81.3	5.1
Total a	Red	5/2	12	18.8%	85.4	6.9	13	18.3%	79.8	5.1	25	18.5%	82.5	6.0
		4/2	39	60.9%	72.0	3.8	48	67.6%	67.8	3.5	87	64.4%	69.7	3.6
		4/1	3	4.7%	76.0	5.0	4	5.6%	73.0	5.0	7	5.2%	74.3	5.0
		3/1	10	15.6%	66.4	3.0	6	8.4%	68.8	3.5	16	11.9%	67.3	3.2
		Unknown	24	-	70.3	3.9	29	-	71.2	3.8	53	-	70.8	3.8
		Total	88	-	72.9	4.2	100	-	70.6	3.9	188	-	71.7	4.0

a. Includes 1 identified onsite as a jack.

Appendix 15. Interview responses by week in the 1990 Vedder-Chilliwack River sport fishery.

	Period ending							Period ending				
	01-Jul	08-Jul	15-Jul	22-Jul	29-Jul	31-Jul	July total	05-Aug	12-Aug	19-Aug	26-Aug	August total
Number of Interviews	42	162	13	34	70	51	372	96	125	89	44	354
Mean Angler Day Length (hr.)												
- All anglers	4.0	3.2	4.2	3.3	5.2	4.9	4.0	5.2	5.5	4.7	5.0	5.2
- Complete trip interviews												
Number	6	16	2	1	0	5	30	2	6	2	1	11
Hours	3.3	1.8	6.0	3.0	-	2.8	2.6	2.8	3.2	4.5	1.0	3.1
- Incomplete trip interviews												
Number	36	146	11	33	70	46	342	94	119	87	43	343
Hours	4.1	3.4	3.9	3.3	5.2	5.1	4.1	5.2	5.6	4.7	5.1	5.2
Mean number of anglers per party	2.5	2.1	1.8	3.2	1.7	1.7	2.1	1.8	1.6	1.8	1.9	1.7
Target Species												
- Chinook	4	7	4	7	63	37	122	83	113	83	44	323
- Rainbow	37	146	5	26	4	12	230	8	8	5	0	21
- Dolly Varden	-	3	2	1	-	-	6	-	-	-	-	0
- Anything	1	6	2	-	3	2	14	5	4	1	0	10
Harvested Catch												
- Chinook adult	-	-	-	-	-	1	1	3	3	2	3	11
- Chinook adult, adipose clipped	-	-	-	-	1	-	1	1	1	-	-	2
- Rainbow	-	15	-	5	1	2	23	1	2	1	-	4
- Rainbow, adipose clipped	19	22	-	3	-	-	44	1	-	-	-	1
- Dolly Varden	-	-	-	-	-	-	0	1	-	-	-	1
- Unknown	10	2	-	-	-	-	12	-	-	-	-	0
- Number	0	24	0	4	2	3	33	4	6	3	2	15
- Number correct	-	24	-	4	2	3	33	4	6	3	2	15
Gear												
- Bait	29	124	10	22	5	10	200	3	4	4	-	11
- Lure	2	23	1	6	56	39	127	83	117	83	43	326
- Bait/Lure	6	3	2	4	9	-	24	9	4	1	1	15
- Fly	5	7	-	2	-	2	16	1	-	1	-	2

Appendix 16a. Daily angler counts in the July 1990 Vedder-Chilliwack River sport fishery.

Month	Date	Day of week	Weather	Time	Angler count a			
					Region 2	Region 3	Region 4	Total
July	01-Jul	Sun	Overcast	0800-0900	b	b	b	42
				1200-1300	b	b	b	73
	02-Jul	Mon	Rain	0600-0700	b	b	b	15
				1000-1100	b	b	b	31
	03-Jul	Tue	Sunny	1600-1700	b	b	b	7
				2000-2100	b	b	b	11
	04-Jul	Wed	Overcast	1600-1700	b	b	b	11
	07-Jul	Sat	Overcast	0600-0800	0	3	5	8
				0800-1000	0	2	7	9
	13-Jul	Fri	Sunny	1400-1600	0	1	1	2
				1800-2000	0	1	2	3
	14-Jul	Sat	Sunny	1200-1400	1	5	20	26
				1600-1800	0	1	7	8
	15-Jul	Sun	Sunny	1200-1400	0	4	5	9
				1600-1800	3	2	9	14
	16-Jul	Mon	Sunny	1200-1400	1	7	0	8
				1400-1600	1	4	0	5
	19-Jul	Thu	Rain	0600-0800	0	0	1	1
	20-Jul	Fri	Sunny	0600-0800	1	0	4	5
				1000-1200	0	1	2	3
	21-Jul	Sat	Sunny	1000-1200	1	5	11	17
				1200-1400	1	5	11	17
	22-Jul	Sun	Sunny	1400-1600	0	8	8	16
				1800-2000	3	5	5	13
	26-Jul	Thu	Overcast	1600-1800	2	3	13	18
	27-Jul	Fri	Overcast	1000-1200	1	2	15	18
				1200-1400	0	6	13	19
	28-Jul	Sat	Sunny	0800-1000	5	0	27	32
				1200-1400	0	3	20	23
	29-Jul	Sun	Sunny	1200-1400	4	5	20	29
	30-Jul	Mon	Sunny	1200-1400	0	1	11	12
				1800-2000	2	0	24	26
	31-Jul	Tue	Sunny	0800-1000	4	2	15	21
				1000-1200	0	4	11	15
	Weekday	Mean c	-	-	0	5	8	13
		%	-	-	2.6%	35.9%	61.5%	-
	Weekend	Mean c	-	-	1	4	15	21
		%	-	-	5.8%	21.2%	73.1%	-

a. Regions were: 2. Highway 1 Bridge to Vedder Crossing Bridge;
3. Vedder Crossing Bridge to Tamahi Creek Bridge;
4. Tamahi Creek Bridge to Slesse Creek.

b. Counts were not recorded by region.

c. Noon to 2 p.m. counts only.

Appendix 16b. Daily angler counts in the August 1990 Vedder-Chilliwack River sport fishery.

Month	Date	Day of week	Weather	Time	Angler count a			
					Region 2	Region 3	Region 4	Total
August	02-Aug	Thu	Sunny	1000-1200	0	3	8	11
				1200-1400	0	2	10	12
	03-Aug	Fri	Sunny	0800-1000	0	3	15	18
				1200-1400	5	1	26	32
	04-Aug	Sat	Sunny	1200-1400	1	2	32	35
				1800-2000	2	2	27	31
	05-Aug	Sun	Sunny	1200-1400	4	2	27	33
				1400-1600	1	3	25	29
	06-Aug	Mon	Sunny	1400-1600	4	1	31	36
				1800-2000	0	1	21	22
	07-Aug	Tue	Sunny	0600-0800	0	1	14	15
				0800-1000	0	0	22	22
	10-Aug	Fri	Overcast	0600-0800	0	2	24	26
				1000-1200	1	1	20	22
	11-Aug	Sat	Sunny	1200-1400	3	0	28	31
				1800-2000	0	1	26	27
	12-Aug	Sun	Sunny	0800-1000	1	1	24	26
				1200-1400	0	0	29	29
	13-Aug	Mon	Sunny	0800-1000	1	1	24	26
				1200-1400	0	0	29	29
	16-Aug	Thu	Overcast	1200-1400	0	0	8	8
				1800-2000	0	0	13	13
	17-Aug	Fri	Overcast	1400-1600	1	1	12	14
				1600-1800	2	0	15	17
	18-Aug	Sat	Rain	0800-1000	0	0	13	13
				1200-1400	0	0	14	14
	19-Aug	Sun	Overcast	0600-0800	0	0	9	9
	22-Aug	Wed	Overcast	1200-1400	0	0	7	7
				1400-1600	0	0	8	8
	23-Aug	Thu	Overcast	0600-0800	0	0	6	6
				1000-1200	0	0	8	8
	24-Aug	Fri	Overcast	1000-1200	2	1	11	14
				1200-1400	1	0	13	14
	25-Aug	Sat	Overcast	1400-1600	1	0	16	17
				1600-1800	1	1	18	20
	Weekday	Mean b	-	-	1	1	16	17
		%	-	-	5.9%	2.9%	91.2%	-
	Weekend	Mean b	-	-	2	1	27	30
		%	-	-	6.7%	2.8%	90.4%	-

a. Regions were: 2. Highway 1 Bridge to Vedder Crossing Bridge;
3. Vedder Crossing Bridge to Tamahi Creek Bridge;
4. Tamahi Creek Bridge to Slesse Creek.

b. Noon to 2 p.m. counts only.

Appendix 17. Daily harvest per angler hour in the July and August 1990 Vedder-Chilliwack River sport fishery.

July			August			
Date	Chinook adult	Rainbow	Date	Chinook adult	Rainbow	Dolly Varden
01-Jul	0.0000	0.2734	02-Aug	0.0338	0.0000	0.0000
02-Jul	0.0000	0.3429	03-Aug	0.0000	0.0000	0.0000
03-Jul	0.0000	0.0000	04-Aug	0.0000	0.0000	0.0100
04-Jul	0.0000	0.0313	05-Aug	0.0293	0.0195	0.0000
07-Jul	0.0000	0.2376	06-Aug	0.0134	0.0000	0.0000
08-Jul	0.0000	0.0833	07-Aug	0.0634	0.0000	0.0000
15-Jul	0.0000	0.0000	10-Aug	0.0000	0.0000	0.0000
16-Jul	0.0000	0.5000	11-Aug	0.0000	0.0000	0.0000
19-Jul	0.0000	0.5883	12-Aug	0.0000	0.0236	0.0000
20-Jul	0.0000	0.0000	13-Aug	0.0137	0.0000	0.0000
21-Jul	0.0000	0.0000	16-Aug	0.0000	0.0000	0.0000
22-Jul	0.0000	0.0000	17-Aug	0.0000	0.0256	0.0000
26-Jul	0.0000	0.0000	18-Aug	0.0000	0.0000	0.0000
27-Jul	0.0000	0.0000	19-Aug	0.0606	0.0000	0.0000
28-Jul	0.0000	0.0000	22-Aug	0.0350	0.0000	0.0000
29-Jul	0.0160	0.0160	23-Aug	0.0540	0.0000	0.0000
30-Jul	0.0000	0.0000	24-Aug	0.0000	0.0000	0.0000
31-Jul	0.0220	0.0440	25-Aug	0.0166	0.0000	0.0000
Total a HPUE	0.0031	0.0891		0.0139	0.0042	0.0007

a. Weighted; see Methods.

Appendix 18a. Total angler effort, chinook adult harvest and HPUE by trip duration in the July 1990 lower Fraser River sport fishery.

Angler day length (hour)	Complete trip interviews		Angler effort		Chinook adult harvest		Chinook adult HPUE
	No.	%	Hours	%	No.	%	
0 - 1.0	2	0.4%	2.0	0.1%	0	0.0%	0.0000
1.1 - 2.0	27	5.3%	53.5	1.6%	1	4.3%	0.0187
2.1 - 3.0	48	9.4%	135.5	4.0%	2	8.7%	0.0148
3.1 - 4.0	55	10.8%	218.0	6.4%	1	4.3%	0.0046
4.1 - 5.0	50	9.8%	243.0	7.2%	3	13.0%	0.0123
5.1 - 6.0	74	14.5%	431.5	12.8%	2	8.7%	0.0046
6.1 - 7.0	58	11.4%	388.5	11.5%	1	4.3%	0.0026
7.1 - 8.0	41	8.1%	319.5	9.4%	1	4.3%	0.0031
8.1 - 9.0	57	11.2%	503.0	14.9%	4	17.4%	0.0080
9.1 - 10.0	31	6.1%	300.5	8.9%	4	17.4%	0.0133
10.1 - 11.0	21	4.1%	225.0	6.7%	2	8.7%	0.0089
11.1 - 12.0	32	6.3%	378.5	11.2%	2	8.7%	0.0053
12.1 - 13.0	5	1.0%	64.5	1.9%	0	0.0%	0.0000
13.1 - 14.0	2	0.4%	28.0	0.8%	0	0.0%	0.0000
14.1 - 15.0	6	1.2%	90.0	2.7%	0	0.0%	0.0000
15.1 - 16.0	0	0.0%	0.0	0.0%	0	0.0%	-
16.1 - 17.0	0	0.0%	0.0	0.0%	0	0.0%	-

Appendix 18b. Total angler effort, chinook adult harvest and HPUE by trip duration in the August 1990 lower Fraser River sport fishery.

Angler day length (hour)	Complete trip interviews		Angler effort		Chinook adult harvest		Chinook adult HPUE
	No.	%	Hours	%	No.	%	
0 - 1.0	0	0.0%	0.0	0.0%	0	0.0%	0.0000
1.1 - 2.0	14	5.7%	27.0	1.8%	1	5.6%	0.0370
2.1 - 3.0	32	13.0%	92.5	6.1%	2	11.1%	0.0216
3.1 - 4.0	28	11.3%	107.0	7.0%	1	5.6%	0.0093
4.1 - 5.0	32	13.0%	155.0	10.2%	2	11.1%	0.0129
5.1 - 6.0	38	15.4%	222.5	14.6%	3	16.7%	0.0135
6.1 - 7.0	29	11.7%	200.5	13.2%	0	0.0%	0.0000
7.1 - 8.0	25	10.1%	195.0	12.8%	1	5.6%	0.0051
8.1 - 9.0	14	5.7%	125.0	8.2%	0	0.0%	0.0000
9.1 - 10.0	14	5.7%	137.5	9.0%	3	16.7%	0.0218
10.1 - 11.0	8	3.2%	86.0	5.7%	2	11.1%	0.0233
11.1 - 12.0	4	1.6%	48.0	3.2%	0	0.0%	0.0000
12.1 - 13.0	3	1.2%	39.0	2.6%	0	0.0%	0.0000
13.1 - 14.0	3	1.2%	42.0	2.8%	0	0.0%	0.0000
14.1 - 15.0	3	1.2%	45.0	3.0%	3	16.7%	0.0667
15.1 - 16.0	0	0.0%	0.0	0.0%	0	0.0%	-
16.1 - 17.0	0	0.0%	0.0	0.0%	0	0.0%	-

Appendix 18c. Total angler effort, chinook adult harvest and HPUE by trip duration in the 1990 lower Shuswap River sport fishery.

Angler day length (hour)	Complete trip interviews		Angler effort		Chinook adult harvest		Chinook adult HPUE
	No.	%	Hours	%	No.	%	
0 - 1.0	55	10.4%	50.5	2.4%	1	0.9%	0.0198
1.1 - 2.0	94	17.7%	173.0	8.2%	21	19.8%	0.1214
2.1 - 3.0	108	20.3%	315.0	15.0%	16	15.1%	0.0508
3.1 - 4.0	86	16.2%	334.5	15.9%	20	18.9%	0.0598
4.1 - 5.0	78	14.7%	380.5	18.1%	19	17.9%	0.0499
5.1 - 6.0	35	6.6%	205.5	9.8%	14	13.2%	0.0681
6.1 - 7.0	24	4.5%	165.5	7.9%	1	0.9%	0.0060
7.1 - 8.0	20	3.8%	158.5	7.5%	5	4.7%	0.0315
8.1 - 9.0	10	1.9%	89.5	4.3%	2	1.9%	0.0223
9.1 - 10.0	13	2.4%	130.0	6.2%	4	3.8%	0.0308
10.1 - 11.0	3	0.6%	33.0	1.6%	2	1.9%	0.0606
11.1 - 12.0	2	0.4%	24.0	1.1%	0	0.0%	0.0000
12.1 - 13.0	1	0.2%	13.0	0.6%	0	0.0%	0.0000
13.1 - 14.0	1	0.2%	14.0	0.7%	1	0.9%	0.0714
14.1 - 15.0	0	0.0%	0.0	0.0%	0	0.0%	-
15.1 - 16.0	1	0.2%	16.0	0.8%	0	0.0%	0.0000
16.1 - 17.0	0	0.0%	0.0	0.0%	0	0.0%	-

Appendix 18d. Total angler effort, chinook adult harvest and HPUE by trip duration in the 1990 South Thompson River sport fishery.

Angler day length (hour)	Complete trip interviews		Angler effort		Chinook adult harvest		Chinook adult HPUE
	No.	%	Hours	%	No.	%	
0 - 1.0	10	14.9%	9.0	4.0%	1	50.0%	0.1111
1.1 - 2.0	21	31.3%	38.0	16.8%	0	0.0%	0.0000
2.1 - 3.0	11	16.4%	31.0	13.7%	1	50.0%	0.0323
3.1 - 4.0	9	13.4%	36.5	16.1%	0	0.0%	0.0000
4.1 - 5.0	5	7.5%	25.0	11.0%	0	0.0%	0.0000
5.1 - 6.0	4	6.0%	23.5	10.4%	0	0.0%	0.0000
6.1 - 7.0	1	1.5%	6.5	2.9%	0	0.0%	0.0000
7.1 - 8.0	3	4.5%	24.0	10.6%	0	0.0%	0.0000
8.1 - 9.0	1	1.5%	9.0	4.0%	0	0.0%	0.0000
9.1 - 10.0	0	0.0%	0.0	0.0%	0	0.0%	-
10.1 - 11.0	0	0.0%	0.0	0.0%	0	0.0%	-
11.1 - 12.0	2	3.0%	24.0	10.6%	0	0.0%	0.0000
12.1 - 13.0	0	0.0%	0.0	0.0%	0	0.0%	-
13.1 - 14.0	0	0.0%	0.0	0.0%	0	0.0%	-
14.1 - 15.0	0	0.0%	0.0	0.0%	0	0.0%	-
15.1 - 16.0	0	0.0%	0.0	0.0%	0	0.0%	-
16.1 - 17.0	0	0.0%	0.0	0.0%	0	0.0%	-

Appendix 18e. Total angler effort, chinook adult harvest and HPUE by trip duration in the 1990 Thompson River sport fishery.

Angler day length (hour)	Complete trip interviews		Angler effort		Chinook adult harvest		Chinook adult HPUE
	No.	%	Hours	%	No.	%	
0 - 1.0	125	16.8%	107.5	4.5%	29	20.1%	0.2698
1.1 - 2.0	173	23.2%	311.0	13.1%	36	25.0%	0.1158
2.1 - 3.0	162	21.7%	458.0	19.3%	33	22.9%	0.0721
3.1 - 4.0	121	16.2%	459.0	19.3%	21	14.6%	0.0458
4.1 - 5.0	67	9.0%	320.0	13.5%	8	5.6%	0.0250
5.1 - 6.0	41	5.5%	236.5	10.0%	8	5.6%	0.0338
6.1 - 7.0	24	3.2%	161.0	6.8%	7	4.9%	0.0435
7.1 - 8.0	14	1.9%	109.5	4.6%	1	0.7%	0.0091
8.1 - 9.0	6	0.8%	53.5	2.3%	0	0.0%	0.0000
9.1 - 10.0	1	0.1%	10.0	0.4%	0	0.0%	0.0000
10.1 - 11.0	4	0.5%	42.5	1.8%	0	0.0%	0.0000
11.1 - 12.0	2	0.3%	24.0	1.0%	0	0.0%	0.0000
12.1 - 13.0	2	0.3%	26.0	1.1%	0	0.0%	0.0000
13.1 - 14.0	4	0.5%	56.0	2.4%	1	0.7%	0.0179

Appendix 18f. Total angler effort, chinook adult harvest and HPUE by trip duration in the 1990 Vedder-Chilliwack River sport fishery.

Angler day length (hour)	Complete trip interviews		Angler effort		Chinook adult harvest		Chinook adult HPUE
	No.	%	Hours	%	No.	%	
0 - 1.0	9	22.0%	8.0	7.2%	2	50.0%	0.2500
1.1 - 2.0	11	26.8%	19.0	17.0%	0	0.0%	0.0000
2.1 - 3.0	10	24.4%	30.0	26.9%	0	0.0%	0.0000
3.1 - 4.0	4	9.8%	15.5	13.9%	0	0.0%	0.0000
4.1 - 5.0	4	9.8%	20.0	17.9%	2	50.0%	0.1000
5.1 - 6.0	2	4.9%	12.0	10.8%	0	0.0%	-
6.1 - 7.0	1	2.4%	7.0	6.3%	0	0.0%	0.0000
7.1 - 8.0	0	0.0%	0.0	0.0%	0	0.0%	-
8.1 - 9.0	0	0.0%	0.0	0.0%	0	0.0%	-

Appendix 19. Variance estimation procedure for acess point surveys (adapted from DPA Group Inc. (MS 1985a)).

CATCH (C)

$$(1) \qquad Var(C) = \bar{c}^2 E^2 \left[\frac{Var(E)}{E^2} + \frac{Var(\bar{c})}{\bar{c}^2} + \frac{Var(E)\,Var(\bar{c})}{\bar{c}^2\,E^2} \right]$$

where: E = estimate study period effort (hours);
$Var(E)$ = variance of the estimated study period effort (Equation 2)
$\bar{c}$ = estimated study period catch per angler hour;
$Var(\bar{c})$ = variance of the estimated study period catch per angler hour (Equation 3).

EFFORT (E)

$$(2) \qquad Var(E) = N^2 \left[\frac{\bar{y}_j^*}{\bar{p}_j^*} \right]^2 \left[\frac{Var(\bar{y}_j^*)}{\bar{y}_j^{*2}} + \frac{Var(\bar{p}_j^*)}{\bar{p}_j^{*2}} - \frac{2Cov(\bar{y}_j^*, \bar{p}_j^*)}{(\bar{y}_j^*)(\bar{p}_j^*)} \right]$$

where: N = total days in the study period;
$\bar{y}_j^*$ = mean instantanous rod count (hour j*);
$Var\ \bar{y}_j^*$ = variance of the mean rod count at hour j* (Equation 4);
$\bar{p}_j^*$ = proportion of daily angler hours occurring at the time of the instantaneous rod count;
$Var\ \bar{p}_j^*$ = variance of the proportion of daily angler hours occurring at the time of the instantaneous rod count (Equation 5).

CATCH PER UNIT EFFORT ($\bar{c}$)

Beacause $\bar{c}$ is a ratio of catch to time of interview ($\hat{x}$)and time fished to time of interview ($\hat{t}$), a Taylor series approximation to the variance of the ratio of random variables was used. Because we expected to interview a relatively large proportion of the anglers, especially at the access point sites, the greatest variance was expected to occur at the stint level; consequently, the following estimate embodies only that sampling stage.

$$(3) \qquad Var(\bar{c}) = \left[\frac{\hat{x}}{\hat{t}} \right]^2 \left[\frac{Var(\hat{x})}{\hat{x}^2} + \frac{Var(\hat{t})}{\hat{t}^2} - \frac{2Cov(\hat{x}, \hat{t})}{(\hat{x})(\hat{t})} \right]$$

where:
$$Cov(\hat{x}, \hat{t}) = \sum_i \sum_j N^2 (1/n_{ij} - 1/N) \sum_f \left[\frac{(\hat{x}_{ijf}\,\hat{t}_{ijf}) - 1/n_{ij} \sum_f \hat{x}_{ijf} \sum_i \hat{t}_{ijf}}{n_{ij} - 1} \right]$$

$$Var(\hat{x}) = \sum_i \sum_j N^2 (1/n_{ij} - 1/N) \sum_f \left[\frac{(\hat{x}_{ijf} - (1/n_{if} \sum_f \hat{x}_{ijf}))^2}{n_{ij} - 1} \right]$$

$Var(\hat{t})$ is analogous to above.

$\hat{x}_{ijf}$ = estimated total catch for the f^{th} stint of the 1^{th} stint type at the i^{th} site;

f_{ilf} = estimated total angler hours for the f^{th} stint of the l^{th} stint type at the i^{th} site;

n_{ij} = number of interview sample days at site i on hour j.

MEAN INSTANTANEOUS ROD COUNT ($\bar{y}_j^*$)

$$(4) \qquad Var(\bar{y}_j^*) = (1/n_j^* - 1/N) \sum_k \left[\frac{(y_j^* k - \bar{y}^*)^2}{n_j^* - 1} \right]$$

where: $\bar{n}_j^*$ = number of instantaneous rod counts at hour j*;
$y_j^* k$ = instantaneous rod count (all sites) on day k;
$\bar{y}_j^* k$ = estimated mean rod count at hour j*.

PROPORTION OF DAILY EFFORT AT TIME OF INSTANTANEOUS ROD COUNT ($\bar{p}_j^*$).

Because $\bar{p}_j^*$ is a ratio of $\hat{R}_j$ and ΣR_j the following Taylor Series approximation to the variance of the ratio of random variables was used:

$$(5) \qquad Var(\bar{p}_j^*) = \left[\frac{\hat{R}_j^*}{\sum_j \hat{R}_j} \right]^2 \left[\frac{Var(\hat{R}_j^*)}{\hat{R}_j^{*2}} + \frac{Var \sum_j \hat{R}_j}{\sum_j \hat{R}_j^2} - \frac{2Cov(\hat{R}_j^*, \sum_j \hat{R}_j)}{(\hat{R}_j^*)(\sum_j \hat{R}_j)} \right]$$

where:

$$Cov(\hat{R}_j^*, \sum_j \hat{R}_j) = \sum_l N^2 (1/n_{ij}^* - 1/N) \sum_k \left[\frac{(r_{ij}^* k \sum_j r_{ijk}) - (1/n_{ij}^* \sum_k r_{ij}^* k \sum\sum_{ij} r_{ijk})}{n_{ij}^* - 1} \right]$$

$$Var(\hat{R}_j^*) = \sum_l N^2 (1/n_{ij}^* - 1/N) \sum_k \left[\frac{(r_{ij}^* k - (1/n_{ij}^* \sum_k r_j^* k))^2}{n_{ij}^* - 1} \right]$$

Var $\sum_j \hat{R}_j$ is analagous to above.

N = number of days in stratum;
n_{ij}^* = number of interview sample days at site i;
r_{ijk} = rod count at site i at hour j on day k;
$r_{ij}^* k$ = rod count at site i on day k at the hour of the instantaneous effort count;
$\hat{R}_j^*$ = estimated total effort (hours) during the instantaneous rod count time block;
$\sum_j \hat{R}_j$ = estimated total effort over all hours and days at the sites surveyed.